Vol. 26 APRIL, 1905 No. 152

THE FOUNDRY

PUBLISHED MONTHLY BY
THE PENTON PUBLISHING CO.
CLEVELAND, OHIO.

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"Everything you need in your Foundry"

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"Fast bind, fast find"

Not a Compound

Gluetrin Core Binder is not a compound of several ingredients, each one to be reckoned with singly and then collectively, but it is absolutely a "flock one."

You can, by adding water, make your Gluetrin solution of any desired strength, but it is so "everlastingly sticky" that a little of it goes a surprisingly long way. With it, and the "gumption" gained by a little experimenting, cores can be made of any sand. Yes:—absolutely any that are quickly dried and extra strong, that will not crumble, nor will they "blow" even when the venting is not by any means as it should be.

There is absolutely no waste in Gluetrin, as when it hardens, water and stirring, quickly brings it back to its best state. Even when mixed with sand and hardened, it can be quickly restored by a tempering with water.

Gluetrin Core Binder turns out more and better work than anything else used for such work, and it also costs less. This makes it "all around" cheap.

When we tell you that a test of "Gluetrin" simply means winning another regular consumer of it, is it any wonder that we gladly send a barrel for test, preparing all freight charges, and then agree (as we do) to take it all back if it fails to "make good?"

Robeson Process Co.

(Successor to AMERICAN GLUTROSE CO.)

Camden, N. J., U. S. A.

"GLUETRIN"

is for sale by

The S. OBERMAYER COMPANY

from their houses in

CINCINNATI CHICAGO PITTSBURGH

The "ACME" of Brass Foundry Requirements

The "STEELE-HARVEY"

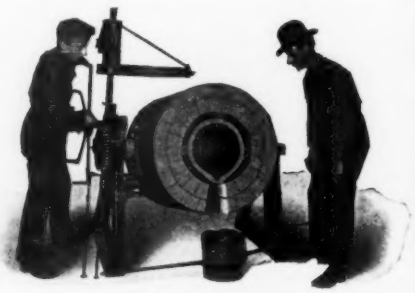
Crucible Melting Furnace

used in connection with Oil, or Gas and Air

For melting Copper, Brass, Bronze, Aluminum, Tin and Phosphor Metals. Special Furnaces for Babbitt and Solder metals, also Lock, Chandelier and Escutcheon Castings (requiring hot and sharp mixtures)

STANDARD STYLE

Furnace in Melting Position



In Pouring Position

No *Clumsy hot hoods* or *expensive stacks* required. Furnace is placed in Foundry with only ordinary ventilation. Employees in the warmest weather can operate with comfort. Dispense with Coke Pits and *contingent loss* of *metal* in *ashes* and *excess labor.*

Cost of manufacture reduced over old methods.

Our Guarantee

No *oxidation, lowest cost* to *melt. Less fuel consumption,* less *waste* of *metal.* Most successful Furnace for reducing *Yellow Brass Borings* and *turnings.*

Capacities from 50 to 900 lbs. per heat. Prices reasonable, deliveries prompt. Write for catalogue stating your particular requirements.

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The Monarch Engineering & Mfg. Co.

BALTIMORE, MD.

Works: Curtis Bay, Md.

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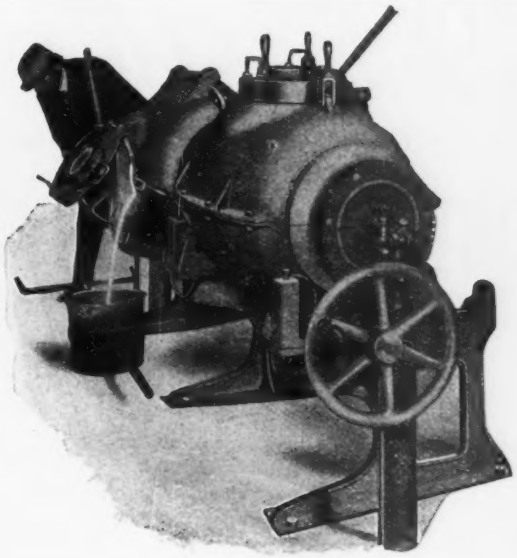
Rockwell Rotary Melting Furnace



SAVES TIME, FUEL, METAL, CRUCIBLES AND TEMPER

Melts Continuously

The Rockwell Furnace is a sort of an alternating furnace. The fire is used at one end—the waste heat passing into the next charge—until the melt is completed, then the fire is turned into the other charge, which has already been brought close to the melting point by the waste heat from the other charge, so that the new charge is melted at once, the waste heat acting on the new charge as before, which means a continuous supply of molten metal, without stops or waits.

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No coal, coke or like fuel is used, so there is no dust or dirt, or waiting for the fire to come up. The Rockwell burns oil or gas, when not melting there is no fuel cost or loss. Started with a match. Stopped by closing a valve. For convenience, cleanliness and economy, it is unequaled.

CATALOGUE FOR THE ASKING

Made in four standard sizes ranging in capacity from 350 to 3,000 pounds each chamber.

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William Sellers & Co., Incorp.

PHILADELPHIA, PA.

MODERN FOUNDRY MACHINERY

SAND MIXER

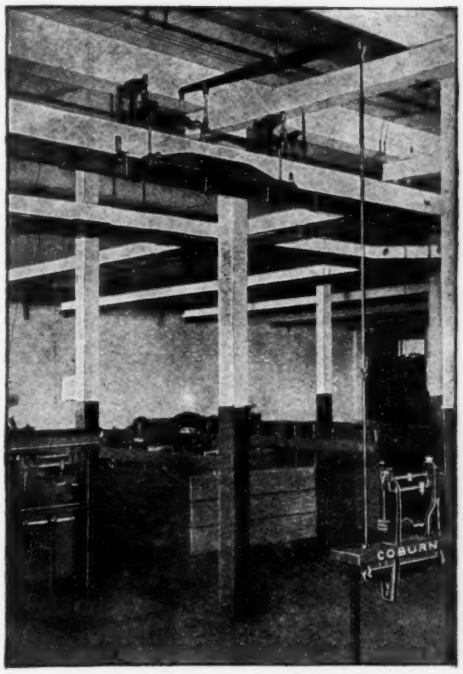
Not an Experiment

PRACTICAL
ECONOMICAL
EXPEDITIOUS

NOTE. — In order to clearly explain the **Modus Operandi** of this scientific and practical method of **mixing Molding Sand, Facing Sand and Core Sand,** we have issued a small pamphlet which will be sent on application.

TRAVELING CRANES FOR FOUNDRY USE.

Correspondence is Solicited.



Do two things at once

Get the exact weight of different brands of iron, coke or any other foundry material while they are being moved from where they are kept to where they are wanted without extra handling or loss of time.

Coburn Trolley Tracks

in your foundry lightens every one's labor

A spur to the flask yard, another to the sand shed, another to the cleaning room and still another to deliver iron to the molders. Flasks, sand, castings or iron taken to any floor without fuss about gangways. The only apparatus for handling materials that's in nobody's way. Think how this would increase the output of your plant, then let us tell you more about how they can be adapted to your special needs.

We'll be glad to tell you.
Send for No. 20 Catalogue anyway.

The Coburn Trolley Track Mfg. Co.
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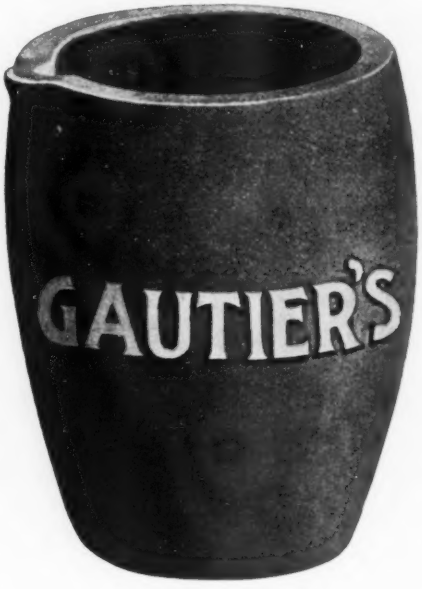
No crucible is better made
or gives longer wear than



To buy—they cost no more than others.
To use—they cost much less.

J. H. Gautier & Co.
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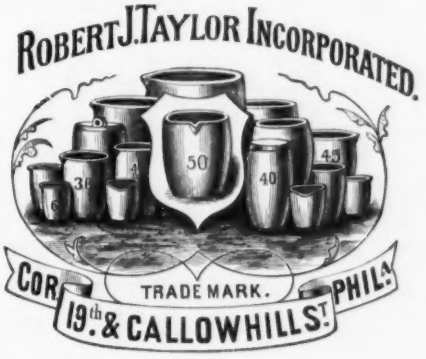

This trade mark stands for the acme of crucible uniformity.

There's no guess work in the manufacture of a Taylor Crucible. Only the highest grades of material are used, and working strictly by our chemical analysis, we give a uniformity in the quality the year round, that is not approached.

A trial will convince you.

Robert J. Taylor, Incorporated

1900 to 1916 Callowhill Street

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What are your Special Needs?

THE making of the Dixon Crucible is not a one-formula proposition. There are as many changes in our mixtures as there are special melting needs and that is why you are getting the best possible when you order a

DIXON

What kind of melting do you have to do?
Let us hear from you.

Joseph Dixon Crucible Co.
Jersey City, N. J.

Figure three pounds of molten metal to every number of McCullough-Dalzell Crucibles.
Uniformity, Capacity, Strength, Quality, Convenience.

Write for Prices

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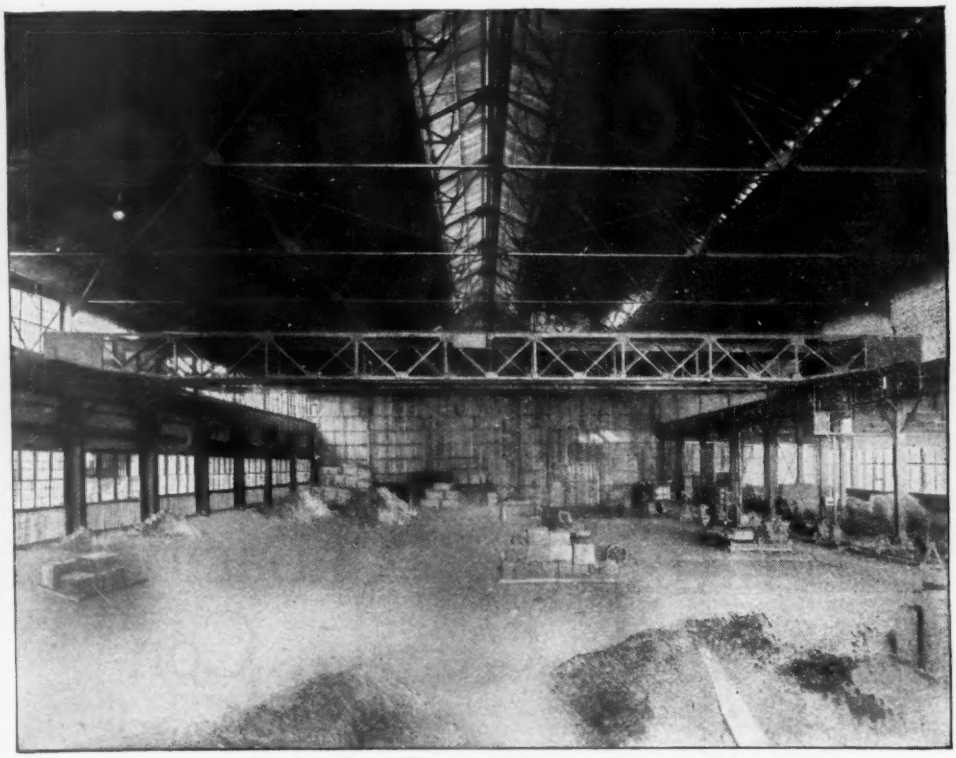


Three-motor Electric Traveler, 10-tons capacity, 98-ft. span. Furnished McCormick Division, International Harvester Co., Chicago.

ELECTRIC TRAVELERS

CRANES OF ALL KINDS

ENGINEERS, DESIGNERS AND MANUFACTURERS

COMPLETE EQUIPMENT FOR
GRAY IRON, CAR WHEEL AND PIPE FOUNDRIES

MALLEABLE AND STEEL CASTING PLANTS

ALL TYPES

OVER 1500 IN USE

Catalog "F" on request

Awarded Gold Medal for Cupolas and Cranes at World's Fair St. Louis 1904.

WHITING FOUNDRY EQUIPMENT CO.

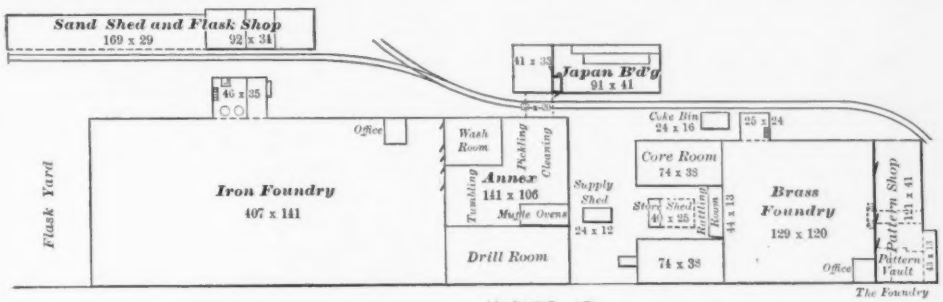
GENERAL OFFICE AND WORKS: HARVEY, ILL., U. S. A. (CHICAGO SUBURB)

THE FOUNDRY

Vol. 26, No. 2. *CLEVELAND, OHIO, APRIL 1905.* *Whole No. 152*

Iron Foundry of the Yale & Towne Mfg. Co., Stamford, Conn.

The high grade of the product turned out by this company would lead one to expect good practice in their various departments and the iron foundry is certainly not disappointing in this respect. To any experienced molder who passes through it it shows evidence of extremely careful work, both as to the manner in which the work is conducted and as to the manner in which it is laid out. Practically the entire output is small work and hence no crane system is necessary. The foundry building proper is 141 by 407 feet. It is divided into two bays, and is amply lighted by skylights, run upon this runway. There are also suitable runways connecting the two bays of the foundry at the ends and at the center opposite the cupolas. The majority of the iron, however, is carried from the cupola in 35 pound hand ladles. Great care is taken to see that these ladles are always in good condition. It is the duty of one man to see that they are properly lined and dried. For the drying of the ladles a special stove or furnace is used. This is situated near the cupola and has six doors in the front which can be lifted up and the ladles introduced with the faces down upon iron



FOUNDRY OF THE YALE & TOWNE MFG. CO.

monitor roof, and side lights. The foreman's office is situated near one end and commands a view of the entire floor. The molding equipment consists of squeezer machines, the floors for each machine being ten feet wide, and varying somewhat in length according to their position in the foundry. There are also a number of bench work floors for use especially in connection with the heavier work. As much of the work is duplicated, great care has been taken in designing the flasks so that they will produce the castings with the minimum amount of sand and also so that they will prevent all danger of straining of the mold or shifting of the parts of the flask. The flasks of each set are interchangeable.

Along the center of each bay there is a runway 8 feet wide made of iron plates, and for their larger work they have truck ladles which bars inside. After the ladles have been lined and air dried, they are placed in this furnace, warmed up and thoroughly baked so that they are ready for use when the iron comes down. For the larger work ordinary shank ladles are used. The drying furnace for the small ladles is fired with coke.

Melting Equipment.

The melting equipment consists of two cupolas, 48 and 72 inches respectively, inside the shell. These cupolas are at present lined to 48 and 36 inches inside the lining. The iron and coke for the cupola are kept in the yard and in sheds adjoining the cupola and lifted to the charging platform by an elevator. The trucks are brought in from outdoors. Blast for the cupola is furnished by an electrically driven fan.

GENERAL VIEW OF IRON FOUNDRY.

Heating and Ventilating System.

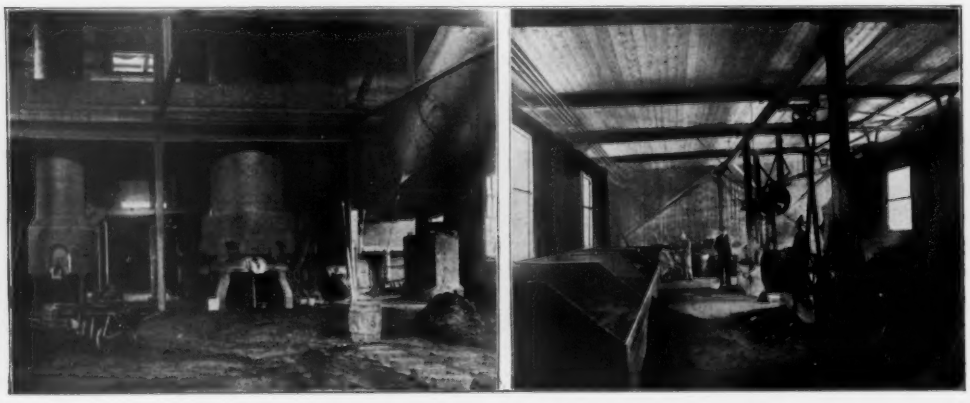
The entire foundry is heated and ventilated by the Sturtevant hot air system, the ventilating plant being located near the cupolas and air distributed to the various parts of the building through suitable ducts.

Preparation of Sand.

Bins having a capacity equivalent to nearly a year's supply are provided for the storage of different classes of sand used for both the iron and brass foundries. The sand for the iron foundry is prepared in a room adjoining the sand storage sheds in which are located a rotary sand sifter, a shaking sand sifter, and a grinding mill. The different mixtures of sand are placed in bins from which they are taken to the foundry in wheel barrows or trucks. As most of the work is light the sand burns out slowly and hence the new facing sand used is in many cases sufficient to keep the sand heap in condition, but the fact that the work is light also necessitates very careful regulation of the facing mixtures to suit them to the work for which they are intended.

Flask Shop.

Adjoining the sand sheds is located the flask



1. CUPOLAS AND LADLE DRYING FURNACE. 2. SAND MIXING DEPARTMENT.

CORE DEPARTMENT.

shop, in which the wooden flasks are made or repaired. Metal flasks may also be fitted up here. In this department the jackets for the snap flask molds are also made. The department is equipped with the necessary wood working machinery for attending to the flask work and whatever carpenter work may be necessary about the foundry.

Core Department.

The same core department supplies cores for both the iron and brass foundries. It is located between the two foundries and receives its supply of sand from either one of the sand mixing departments. The most of the cores are small cores made from carefully fitted metal core boxes and are dried in Millett ovens located in the room. The core department is lighted by windows on the sides and the end and also by skylights along the monitor roof. On account of the highly specialized work it is necessary to specialize in the core work also, and as a consequence very high grade metal core boxes are used in most cases, and great care is taken to design them in such a way that the operators can handle them easily and rapidly.

Finishing of the Castings.

The light nature of many of the castings necessitates very careful treatment in the finishing departments. These departments occupy several rooms at the end of the iron foundry. First, there is a battery of tumbling barrels for cleaning any class of castings for which this is suitable. There is a pickling bed for pickling castings upon which scale is objectionable, and a series of annealing furnaces for annealing the lighter grades of castings. Many of the castings require no finishing except the drilling of a few small holes and hence a department called the drilling room is located next to the cleaning room and in this much of the work is finished by drilling in jigs on drill presses, so that the parts go directly from the foundry to the japanning department or the assembling department.

1. FLASK DEPARTMENT.

2. CLEANING DEPARTMENT.

CORE SAND BINDERS.*

BY J. S. ROBESON.

It is true that every material used for this purpose is a compound; but so is the sand a compound; so is the pig iron a compound; though certainly no salesman has yet had the nerve to offer you any Carnegie chill casting compound under the impression that you would recognize it as pig iron. The materials in question are employed solely for their adhesive qualities.

You may say that they do other things, but be that as it may, the basic reason for their use is to bind the sand together so that it will take and hold the desired shape. Certainly such a material is a sand binder and when used for cores, a core sand binder. This is my plea and I hope my justification for the new name. Perhaps this question of a name is along of a line with some other points in core shop practice in that they need more attention, that they need changing, that they need reform. It has been brought forcibly to me again and again as I travel from foundry to foundry that the core shop has suffered, and is suffering from neglect.

On page 157 of *The Foundry* for December, in an article by Charles A. Smith, note the following words; "Every superintendent ought to get acquainted with his core room foreman and give him credit for what improvements and additions he can make in the department, for the core room is certainly an important department and much saving can be made here by close attention to details." That is a strong call from the man in the shop. Can you afford to be deaf to it?

Because you happen to pick up—after a few trials—a man who can make cores without much loss of labor, sand or castings with the local sands and binding materials, hence the convenient ones, or with some that he or you used elsewhere with success, then you think your problem has been solved. And you are wrong.

I believe that I am perfectly safe in saying, and this without any intention of throwing bouquets at you, that in addressing the Foundrymen's Association of the Pittsburg district; I am addressing the men who have made a closer study of the business than any other such body in the United States and yet I doubt if there are five of you tonight who can tell what their binders cost per ton of sand mixed; not half who can tell off hand, with any accuracy, what their core sand mixtures are and I will warrant if there are any who think they know, that one visit to their core room will prove they are in error.

For a reason, which is not quite clear to me, the men in this trade, do not get the assistance from the shop foreman, the foundry superintendent and the office force that the molders or the cupola-men receive. A man who is thus forced to work out his own salvation, alone and unaided, without help or assistance from that part of the management that is supposed to know more, will naturally make workable cores from the materials at hand, if he can. They may be the best, they may be the worst permissible, but he does not know the degree of their goodness or badness nor anything as to cost and this because there is no method of comparison.

Here is a trade without a literature. Can you expect progress from a nation without a written language? In what is probably the most read book of the few relating to the foundry trade, there are just 4½ pages devoted to core making out of nearly 400, and half of these 4½ pages is padding. This neglect has brought about another condition of affairs. The sand, the binders, the manner of drying have been worked out for each foundry and the coremaker that lasted long enough to get good results has held the job until he and not the office was tired. This fact has made him narrow, localized and with a high opinion of his own skill in sands and binders and therefore difficult to teach. As an example of this, and also of several other related points, I recollect meeting a boss coremaker a short time ago who was dissatisfied with the results he was having.

This in itself was remarkable, and especially so, because in my business of selling a core sand binder, I had just left the office of the company he was working for, where I had been told that they could not even listen to my story because they were getting good results from their cores and there was no use in disturbing any part of the plant that was running smoothly and well. It turned out that this man had been working for a rival concern, located a few miles away, and because of his good results had received and accepted an offer from his present employer, who at the time was having trouble from excessive breakage of cores, much blown work and many condemned castings, owing to defects in the cored work. Now he had used my binder in

*Read at the February meeting of the Pittsburg Foundrymen's Association. Mr. Robeson is president of the American Glucose Co.

the old shop and I was, of course, curious to know why I had lost his trade and anxious to secure it again. I knew something of the sands in that locality and after an examination of those he was using, I worked out the following story. The figures that I now give are not the actual ones but are relatively correct.

The sand mixture in his old shop was:

30 percent old or gangway sand.....$0 00
30 percent loamy sand, at $1.80 per ton.. 0 54
40 percent bank sand, $0.75 per ton..... 0 30

Total $0 84

One part of gluetrin to 40 parts of sand.

This binder cost 15c per gallon or 3¾c per quart delivered. The sand ran 900 quarts to the ton and on these figures the binder cost 84 cents per ton of sand mixed and the total cost for each ton of core sand, ready for cores, was $1.68.

The new shop had been using,

40 percent sharp sand at $1.20 per ton...$0 48
60 percent loamy sand at $1.80 per ton... 1 08

Total $1 56

1 part of flour to 12 parts of sand.

Flour at that time cost $25.00 a ton and on a weight of 1.1 pounds to the quart the cost of binder per ton of core sand mixed was $1.03 and the total cost for each ton of core sand, ready for cores, was $2.59 per ton. The work from these cores was bad. They had tried rosin, on and off, with equally poor results.

With these two sands, which were different from the loamy and sharp sands of his old shop, this man tried, with and without old sand, gluetrin as he had used it before and failed. He then went back to the original practice of this shop—flour—and by changing the mixture slightly and seeing that the proportions of the sands and the sands to the flour did not vary, and forbidding the coremakers to run to the flour sack whenever they liked, which had previously been allowed, he managed to get much better results than they had formerly secured. This satisfied the office but the work was not as good as in the old shop. He knew it and was dissatisfied but apparently helpless. Here was a man that looked ready for my material and, in spite of his failure, was easily persuaded to try it again.

I was certain after examining his sands that the whole trouble was in the sand mixture and several were tried, this being finally adopted as the most satisfactory and economical.

40 percent old or gangway sand.....$0 00
40 percent loamy sand at $1.80 per ton.. 0 72
20 percent local bank sand at $0.75 per ton 0 15

Total $0 87

1 part of gluetrin at 3¾c a quart to 50 parts of sand cost 67½c per ton of sand mixed and the total cost for each ton of core sand, ready for cores, was $1.54½.

This was successful, reduced the breakage of cores and did away entirely with any blown castings or trouble from the size of cored holes, besides making a clear saving of $1.04½ on each ton of core sand mixed. But note—here was an intelligent man of his class, holding a responsible position—he had charge of twenty-five coremakers—who, after one or two trials had given up his problem and drifted back into practically the same methods as this shop had always used. It seems to me that there were two causes at work here. The one that his superiors did not know enough to push him for better results nor to aid him with suggestion, and the other, that he, himself, lacked sand experience—did not realize that simply because sands look alike they may be different and that one or two trials are not sufficient to test a sand or a binder. Incidentally he learned how to figure the cost of his mixture; something he had never done before.

Under this heading of Core Sand Binders, any material possessing adhesive qualities might be included. Local conditions and sands have caused the use of some that seem absurd to the general trade. A consideration of these freaks is omitted and only those that are found in general use are considered. These are:

Solids

1. Dextrine
2. Flour
3. Proprietary Dry Mixtures
4. Rosin

Liquids

1. Fish oil
2. Glue
3. Gluetrin (Proprietary Liquid)
4. Linseed oil
5. Molasses
6. Proprietary Oil Mixtures
7. Rosin oil

At the first glance it is seen that these can be divided into two distinct classes—the solids

and the liquids. It is to the difference in action of these two conditions of matter, when used as core sand binders, that I wish especially to call your attention, and not to the merits or demerits of any particular one.

Let us consider the work that is required of a binder. The local conditions in each shop vary greatly and it is only possible to name these requirements in a general way.

A good binder must make a core that

1. Is strong both green and dry.
2. Is weak and rotten after the casting is cooled.
3. Is not easily affected by moisture.
4. Will give off but little gas.
5. Will dry quickly.
6. Will not change in size.
7. Has a low cost.

The ideally perfect core sand binder is one that mixes easily with the sand, making a mass that packs with but little work in the box, leaves it freely and leaves it clean. Is strong enough before baking to stand alone, without sagging or deformation and retain sharp edges. Such a core must now bake in the shortest possible time and when baked be hard enough to stand rough handling, be weak enough to yield to the contraction of the iron in cooling, porous enough to permit the gases to escape freely, and after cooling leave the casting easily and cleanly.

The usual method of preparing the mixture is to put on the floor the required quantity of each kind of sand, previously selected by the foreman or boss core maker, and to spread or sprinkle on top of this pile the necessary amount of the dry, or liquid binder that is to be used, afterwards wetting the mass, as may be required, with water.

This pile is then cut over and shoveled, being finally put through a riddle and then delivered to the coremaker or put in a pile ready for their use. There are various modifications of this practice in the way of riddling the sand before the binder is put on, mixing in a machine, etc. Every step that is taken to increase the thoroughness of the mixing is a step taken in advance. The more perfect the mixture the better the core.

If you are using a dry binder, flour for example, and it is simply dumped on the pile of sand, wet down and put into barrows, wheeled to the coremaker and made up into cores, you will have a core that consists of a gob of flour with a little sand in it, next to a gob of sand with a little flour in it.

It does not take a very wise man to know that such a core will be weak and it is a fair presumption that when the hot metal strikes one such loaf of bread in the core there will be a large volume of gas given off at the point and a resultant blown casting. This is actually the condition that exists in every core made with a dry binder to a greater or lesser extent. The more thoroughly the sand and binder are stirred and mixed together, the more even will the distribution be and the more nearly will the ideal condition be reached of having each grain of sand surrounded and attached to the next grain by the binder. For this reason dry binders should be very finely ground—be very much finer than the sand. This condition of fineness is true of flour, not quite so true of rosin and not nearly so much so of the dry binder mixtures on the market.

Flour is delivered in a much more finely ground condition than any particle of ordinary sand and if kept dry, will remain loose and free from lumps. Rosin is not usually, in fact I think never, so finely ground but, even if so, will immediately, because of the moisture and heat in the air, under normal conditions, commence to stick together and ball up. All the dry mixtures sold will act in the same way as rosin, in varying degrees, so that the result, with these two latter materials is that, however much labor may be spent on the mixing, the mass will never be nearly so uniform as with flour.

If flour is therefore the best, let us see how bad it is. The sand is composed of grains, varying in size from particles as small as a needle point up to ¼ inch. The variation in the shape of these grains is much greater than in the size and in fact the shapes met with are so various that they cannot be numbered. This matter of shape, as long as the size is within the limits already mentioned, is the most important. Roughly speaking these grains may be divided into two kinds, those that are angular having sharp corners and numberless projections and recesses; those that are rounded, the projections having been rubbed off so that the grain is a more or less true sphere with a highly polished surface.

Some years ago I was engaged in the manufacture of steel by the basic Bessemer process and, as part of our practice, it was necessary for us to make dolomite bricks. For this purpose we used an exceptionally pure dolomitic limestone, which was crushed in a jaw crusher, then pulverized to nearly the fineness of flour, dampened with water and pressed into building brick form and size on an ordi-

nary brick press, then calcined at a very high temperature. The work of making these bricks was progressing very satisfactorily, the breakage in handling from the brick press and in piling in the kilns being practically nothing when there was offered to us a limestone from another quarry. Repeated careful chemical analyses of this stone, showed that it differed but little from that we were using. If anything it was more nearly pure and a contract was placed for a larke tonnage. Shipments arrived and were dumped and used indiscriminately with the older stone. Later investigation showed that they were probably in about equal proportions in the stock pile, so that the pulverized material coming to the brick press was about half and half of each stone. With its use trouble immediately resulted. The bricks were very weak, as they came from the press. Fully 25 percent were broken in the handling at this point and from 10 to 15 percent more when piling in the over. Various means, such as increasing the water, the pressure on the press, etc., were tried but with no success in doing away with the trouble. Instant relief was necessary so that the use of the new stone was stopped, with an immediate stoppage of the trouble, while the investigation proceeded. The microscope finally told the story, as it showed that the older stone crushed and pulverised into granular grains, while the newer stone gave almost perfectly rounded particles. The geological explanation carried this back to the manner of the original deposition or formation. It can easily be realized that under pressure these granular pieces would knit into one another, projection into recess, so that their very shape made a strong bond, whereas the rounded grains would simply have their polished curves the one against the other—without bond and in fact of a position and of a shape to encourage a sliding or rolling action and consequent weakness and breakage. This same story is exactly and similarly true of the core sand. The bond is increased in the cores, however, by the use of some added material, that by the aid of water or of heat becomes adhesive or is so of itself. This, however, is but an aid. It does not change the condition produced by the first shape of the sand grains. The more angular they are the less work the added adhesive has to do, the more rounded, the greater the work.

There is a common expression used in the foundry, that a sand is sharp, and on examination, I have found that such a sand invariably shows the angular grains to which I have referred. I have not come across, however, any expression or word or name, that denoted the reverse of this condition, the non-sharp kind. All of the non-sharp kind that I have used contained some loam or clay, so that for want of a better name, I have called this loamy sand. Now I do not know whether it is true or not that these rounded grains only occur with the loamy admixture. It is my experience, however, that the two always appear together, and when they do so appear, that the loam acts as a binder. Thus the two kinds of sand, the sharp sand and the loamy sand, are both, in a measure, self-binding though from entirely different causes and the bond, as formed, is of a different nature. I have never found a case where, what might be termed the angular bond, was strong enough to make a core without an added binder, but I know of one loamy sand, and there are probably others, from which hard cores can be made without the addition of any adhesive.

In the New England district the universal base of all core sand mixtures is beach or bank sand and the usual binder is flour, together with a small amount of the proprietary dry mixtures. These sands are sharp, of varying degrees of fineness, and in all probability from the same source, the sea shore. The present beach sand being sometimes dug from a little distance back from the tide line, or directly on the beach, thus subject to daily intermittent soaking with salt water, or dredged from under the water. It may thus be more or less weathered or strongly impregnated with salt. The bank sand is from inland points and if these deposits are, as I think, but the remains of an ancient sea shore, then the only difference between the two sands is that the one has been weathered and washed free from salt and the other has not.

In the foundry district in and around Philadelphia there is a very large amount of Lumberton, Millville and other sands containing loam or clay used. The characteristic core sand of this section is thus a loamy sand and the usual binder is flour and a certain amount, greater I think than in New England, of the proprietary dry mixtures. Here now are two sands entirely unlike in their physical conditions and self-binding powers that are in practice bound and made into cores with the same adhesive material—flour—and requiring about the same amount. It is evident, therefore, that the binding power of the angles on the sharp sand is replaced by the adhesive property of the loam in the loamy sand. From this view

of the situation, it would seem that it made no difference which sand was used, that the one was as good as the other.

There is, however, a very great difference in the structure of the two cores. With the sharp sand, the angles fit into one another but not perfectly. The flour particles press into the recesses, rest on the projections and lay against the body of the grain but not flatly, completely, perfectly, the very irregularity of the shape makes the joint between the grains of sand themselves, as well as with the binder, imperfect, and as a consequence the mass is not solid nor compact but consists of grains tightly and perfectly joined at different points to the surrounding grains but with open and unjointed parts at other points. In other words, the interstices are not completely filled. Thus the core is porous, though strong, with ample opportunity for the travel through its interior and out to the surface of any gases that may be generated.

With the loamy sand the story is different. Here the binding is entirely dependent upon the adhesive strength of the loam and the flour. With the addition of water these two mix intimately and easily, and as the rounded and polished surfaces of the sand grains come together under the pressure of the ramming, this fluid mass of adhesive, greater in proportion to the whole mass with the sharp sand, you must remember, is forced and flows into the open space between these grains a much smaller space than with the angular sand and as a consequence these intergrain spaces, that would form passages for the travel of the gases, are almost closed up. In other words, the interstices are almost completely filled. Thus the core is strong, with the same amount of flour is actually stronger than when made from sharp sand—but very dense and compact. As a proof of this you will find that the man who is using sharp sand as his base for cores, seldom or never talks about trouble from his cores blowing. He cares little whether the core sand binder offered him has gas in it or not but the man using the loamy sand is ever on the watch for that point. He knows that he must be careful and, because flour gives off so much smoke and gas when the hot metal strikes it, he is ever seeking for a substitute that will give him less trouble and reduce his loss from core-blown castings.

Now it has been noted that the binders commonly used can be divided into two classes, the solids and the liquids, and also that in preparing the core sand mass, water is invariably added. With the exception of the rosin all of these dry binders are more or less soluble in water. The rosin, after it has been mixed and molded, likewise becomes liquefied or partly so, because of the heat in the core oven. At the first glance it would seem then that they all became liquids during the operation and that there is thus really but one class of binders. This is not entirely correct, because, first, some of the mixing is usually done before the water is added, and, second, because only enough water can be added to make the mass properly damp for ramming. This amount is not sufficient to make the dry binder thin, fluid, and in a condition to run freely through the sand. The most casual examination of a rosin made core, will show that the sand and binder are very improperly mixed. The rosin can be seen in spots throughout the mass and it is, as a fact, the poorest and per unit of volume, the most expensive of the binders, mainly because of the impossibility of proper mixing. This but goes to prove, the well known fact, that a more uniform mixture can be attained when a liquid and a solid are put together than when two solids are used. The thinner the liquid the more easily will it run through the mass of sand and the more rapidly and completely will it cover each grain. It would, therefore, seem that a liquid binder would, with the least work, give the most perfect mixture, provided, of course, that it was thin enough when put on the sand to flow freely through it. It must, also, be sufficiently adhesive per unit of bulk so that the amount added will not make the sand too damp.

Some experiments recently made, for the purpose of proving this theory, showed that the efficiency of all of the dry binders could be increased by better mixing but that the expense of so doing was greater than the cost of the binder that was saved as, aside from the difference between hand and machine mixing, this means, simply, longer continued work on the sand mass. With the liquid binders a somewhat different method seemed possible. Having the idea in mind that the thinner the binder the better the mixture, a material was selected, gluetrin, that mixed easily and readily with water, and a test was then made by putting this on the sand in the form of a spray with compressed air. At the foundry where this was tried their regular core sand mixture was:

20 percent old or gangway sand.....$0.00
60 percent Millville gravel @ $1.40 per ton 0.84
20 percent local sharp sand @ .90 per ton 0.18

Total.....$1.02

One part gluetrin mixed with one part of water to each 50 parts of sand.

This sand ran 930 quarts to the ton and the binder, therefore, at 3¼c a quart, cost 70 cents per ton of sand mixed and the total cost for each ton of core sand, ready for cores, was $1.72. Their practice was to put the sand on the floor in three layers as dumped from the wheelbarrows. This was then shoveled and cut over about three times while dry. The gluetrin had previously been mixed with an equal amount of water and was then sprinkled over the bed of sand from a watering pot. The pile was shoveled over once, sprinkled with water, and put through a riddle on a pneumatic shaker and taken to the coremakers. In the first test with the compressed air spraying, the same amount of gluetrin and water was used and the cores were entirely too hard. Various trials were made until now their practice is to wheel in the sand and to put it on the floor as formerly but as the sand is shoveled and cut over, while dry, it is thrown rather high from the shovels and is met by a spray of gluetrin and water. This is done twice and it is then put through the riddle as before.

The sand mixture is now:

40 percent old or gangway sand.....$0.00
40 percent Millville gravel @ $1.40 per ton 0.56
20 percent local sharp sand @ .90 per ton 0.18

Total.....$0.74

One part of gluetrin, mixed with two parts of water, to 70 parts of sand. Thus the binder costs but 50 cents per ton of sand mixed, and a total cost of $1.24 as compared to $1.72—a saving of 48 cents per ton.

Here is a credit for old sand, binder and labor due to the method of mixing alone, and a small debit for compressed air. As the oils and oil mixtures are too expensive per unit of volume for general use, and this without regard to their merits or faults in any other respect, but few tests were made with them. Such as were made, however, agreed with this result.

AIR COOLED AUTOMOBILE CYLINDERS.

BY JOHN J. BEERS.

In response to the article in the February issue of *The Foundry* on the loss of air-cooled automobile cylinders, I wish to make the following statement. Possibly every one who reads *The Foundry* knows that this is one of the most delicate classes of work that the foundryman has to contend with. It requires the utmost care and attention on the part of the coremaker to produce sound castings. In my everyday practice on this class of work I follow four or five rules which I have applied in making the cylinders, and have been successful both in steam and gasoline engine work. First, be absolutely sure that the core is thoroughly vented and all vents connected. Second, be equally sure that you have sufficient outlets to relieve the core of any gas pressure from the gases formed in it. Third, if there are any outlets from the top of the jackets, take care that the projections to form these openings are not longer than the prints on the patterns, as if this is the case, the cope will press too hard on these points and strain the core until the joint opens. This allows the iron to flow into the core, resulting in a bad casting. Fourth, if the above precautions do not produce sound castings the molder should be cautioned against ramming too hard or the use of too wet sand. In my own practice I never dry the molds.

A Complaint.

Iron went up two cents today,
Will it go more tomororw?
The broker's price we have to pay,
Iron went up two cents today.
I wonder what the "firm" will say?
I'll soon learn to my sorrow,
Iron went up two cents today,
Will it go more tomorrow?

W. L. ZIMMERMAN.

Molds for Making Repairs with Thermit.

The sand used in making molds for thermit castings must be clean, hard and sharp. Such sand, mixed with an equal amount of ordinary brickmakers' clay, will make satisfactory molds. If fire clay is used the molds should be composed of 65 percent fire clay and 35 percent sand. Fire clay molds, however, are hard to dry.

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TRADE OUTLOOK.

The foundry pig iron market has not changed materially during March, though there has been a good aggregate of sales to a variety of buyers in different parts of the country. No. 2 Southern iron can still be had at $13.50 at furnace, in large lots, though small lots in some cases have brought $13.75. On Northern iron the Central Western furnaces are quoting $16.00 a ton. In Southern Ohio some iron has been sold in the past month at $15.50 per ton at the furnace for No. 2 foundry, though it is probable that at present it would be difficult to obtain it for less than $15.75. The pipe interests have been buying since our last report.

Reports are coming in from all parts of the country showing that there are orders for larger tonnages of castings on the foundrymen's books than there have been for a long time, and the general outlook in this direction is very encouraging. The increase of orders on the books of the foundrymen has caused many of them to place orders for foundry iron.

The malleable interests have received a considerable tonnage from the agricultural trade, but orders for malleable iron for railroad and car work have not been equally conspicuous. This is probably due in part to the fact that cast steel has been replacing malleable iron to some extent in connection with these lines of manufacture. On the other hand malleable foundries have gained, perhaps, at the expense of gray iron foundries.

The steel foundries report a great increase in the number of orders received and most of them are running with practically a full force of men; some, in fact, are working over time.

The price of foundry coke has increased somewhat, and there are indications that it may go still higher. Ordinary foundry coke is now quoted at $3 per ton at the oven in the Connellsville region and $3.25 is asked for special grade. It is probable that steady or slightly increasing prices will rule in foundry lines for some time, on account of the fact that the prices of the blast furnace raw materials that is iron ore and coke are both increasing and that the railroads are showing a tendency to put freight rates back where they were before the slack times of 1904.

All this means that if the foundryman is to conduct his work at a profit he must obtain a somewhat higher price for his castings, and such re-adjustments as this always take time.

MANUFACTURE OF BY-PRODUCT COKE.

In another part of this issue we publish an article on By-Product Coke, telling of its manufacture and also of the manufacture and use of some of the by-products. As by-product coke is becoming more common and is being used by foundrymen in many centers, it is but natural that all foundrymen should be interested in the subject and in the matter of its production, and we are glad to be able to present such a good article on the subject. The paper was read before the Philadelphia Foundrymen's Association.

NEW BOOKS.

"High Temperature Measurements," by H. Le Chatelier and O. Boudouard. Authorized translation by G. K. Burgess. Published by John Wiley & Sons; second edition. Price $3.

This book contains 341 pages of very interesting matter descriptive of pyrometers and high temperature measurements. Formerly such a work would have been of interest only to the scientific investigator in connection with laboratory work, but now that pyrometers are used so extensively for the control of temperatures in all classes of metallurgical work, the subject has become one of vital interest to all connected with the different branches of the metal industry in which the metal undergoes heat treatment. In this work the authors in the preface give a short review of the history of high temperature measurements and then follow with an extensive treatment of the subject of high temperature measurements, describing the many different devices which have been invented for this purpose and showing the relative advantages of each.

Considerable mathematics has been used in some portions of the work, though one not familiar with higher mathematics would gain a great deal of information by reading the other portions of the book.

A CASTING DIFFICULTY.

BY O. B. CECIL.

In answer to the matter entitled "A Casting Difficulty," by A. L. B. in a recent number of *The Foundry*, I may give the following experience with this kind of work. Some years ago, I had to cast some rolls of the nature described, and after spoiling several, I tried the following method with success. I had a pattern made with the prints one-half inch out of center, and molded them with the print nearest the bottom and in a horizontal position. In preparing the mold, I placed 2½ inch shrinking heads along the pattern every eight inches and dried the mold thoroughly, using a sand mixture that would bake very hard. I heated the shaft red hot and placed it in the mold a few minutes before pouring. The iron was melted to a white heat and in pouring I allowed the metal to flow through the feeding heads until the iron lay perfectly quiet and then used a churning rod until the metal was congealed. Castings made in this way turned up nice and clean. Very little stock is required on the bottom or under side of the casting and by allowing all the stock on the top it enabled me to be sure that the work would turn up clean. I wish to lay great stress on the fact that the shaft must be as hot as possible and the cast iron must also be very hot or good results will not follow.

I also had a great deal of success in casting brass bearings in driving wheel boxes made of cast iron. This saves a great deal of expense in a machine shop, which is quite an item in a big railroad system. In doing this it is necessary to have the iron boxes hot before pouring the brass.

*CHEMISTRY IN FOUNDRY PRACTICE.

BY N. W. SHED.

The last fifteen years has brought a great change in the making of cast iron. Before 1890 little attention was given to the different grades of cast iron, but since that time machinery manufacturers have demanded a hard, wear resisting metal and also a soft metal which may be easily machined. The control of this metal is governed by its chemical composition and for this reason chemists have come from the blast furnace and steel making plants to the foundry. Before 1890 the chemist was looked upon as an ornament or a fad, and most foundry men wondered why they were allowed to exist, and to some foundrymen today the chemist is looked upon as a close ally of the devil and his suggestions are regarded as rank heresy to the orthodox teachings of the old practice. The feeling was much the same among the old blast furnace men twenty odd years ago.

In the old days a man that made soft iron did not dare to make hard iron. Only four years ago I met a foundryman who would not make a pully for his own shafting. He would

*Read at meeting of Buffalo Foundrymen's Association, Feb. 21.

have to make them of harder iron than his regular mixture, so he went outside and bought his pulleys. He said, "Nobody shall ever accuse me of making anything but dead soft iron," and he keeps his word, for all his iron simply crumbles as the tool steel strikes it. The hard iron was usually a question of luck and scrap. When the scrap was hard, the iron would be hard; if the scrap happened to be soft the iron was soft, but was called hard. The method of mixing irons was a curious mixture of good judgment and superstition. A great many pigs were broken and the fractures examined. It took a good observer and a good guesser to judge iron by fracture and in case there was doubt it was considered the thing to put in a good dose of Scotch. Scotch iron was a panacea for all iron ills and was supposed to be a softener. Then there were some special strong irons, which were spoken of with a certain reverence and were supposed to have virtues handed down from the remote past. These were known to gain strength from the hills whence they were made. These were mixed with the Scotch, and scrap added with fear and trembling. Occasionally white iron was seen, but this was regarded as the black beast of iron founding and any one charging white iron into a cupola was looked upon as insane or a tempter of providence.

The grading of iron by fracture was one of the difficulties in the old method of mixing. At one time there were nineteen different No. 1 irons. They varied from ½ percent silicon to 4 percent and were all No. 1. No. 3 in one brand would match No. 1 in another. No. 1 and No. 2 were usually confused, and often No. 2 was supplied for No. 1 and the founder paid the No. 1 price. When we know that two or three grades of iron can be distinguished on a single pig, when we know that a No. 3 grade can be transformed into a No. 2 grade by slower cooling, when we know that iron cast in a dry pig bed is a lower number than iron cast in a wet pig bed, we can form some idea of the difficulty of grading by fracture.

It would be interesting to know how many foundrymen still cling to this method of grading iron. No doubt many think that the iron is graded by fracture, but, if the truth were known, every ton they receive is graded by analysis. But this handling of iron by number and by tradition is unknown to the mixer by analysis. The chemist ruthlessly cuts into the iron with two acids, separates the graphite, silicon, sulphur, phosphorus and manganese and marshals them into columns, and now the mixing is simply a pairing off of these substances:

A high silicon with a high phosphorus; a low silicon with a low phosphorus; a low manganese with low sulphur; a high manganese to carry off sulphur; low silicon and low phosphorus for strength; high silicon and high phosphorus for softness; a low silicon and high manganese for close grain.

Nothing is left for guess. A formula is decided upon and the various irons are figured to so mix that the result shall not vary over one-tenth of one percent. The old method was more picturesque, but the modern method is more sure. There are foundrymen here who will admit that mixing can be done better by analysis, but they say the blast furnace people make the analysis of every carload of pig, and that is good enough for them. This may do in making the softer grades of iron, but when it comes to making hard iron the furnace analysis is seldom reliable. The fact is the analysis given of the carload is not an analysis of the pig in that car, it is simply an analysis of the cast from which that carload was loaded. As one cast of iron may vary from 10 to 60 in silicon it is easy to see that a man may get a carload of iron of which the furnace analysis is 1.50 silicon, but the actual analysis is 1.00 silicon. If he goes on the supposition that the furnace analysis is right, he will get white iron if he uses any hard scrap, and he will probably get all his light castings white if he uses nothing but pig. These cases are happening right along. Castings that should be 1.25 to 1.60 percent silicon, have finished below .70 silicon because the furnace analysis did not represent the car. The blast furnace sample is taken from the liquid metal as it runs from the notch at the furnace, and though the analysis of that sample doubtless is correct, yet that sample is very different from one obtained from the car itself. Another disadvantage of relying on the blast furnace is that the furnace people will claim that the only satisfactory iron is supplied by them. The claim is often made that the ores, limestone and even air used by them have a marvellous power to give both strength and softness to the iron, while ores and air of a rival furnace have no such power. If this claim is admitted by the foundryman, he is at the mercy of the pig iron maker, and the blast furnace fairly owns the foundry. This shuts out the foundry from the open market when prices are much lower. If the foundryman is free to buy, he can often

pick up lots of off malleable or off basic iron which he can use to advantage. In the same way, many lots of scrap, two or four dollars below the price of pig may be picked up and the right pig bought to go with it.

But the great value of the chemist to the foundry is in the making of special irons.

Some castings must be very strong, some must resist corrosion by acid or alkalies, some must expand and contract with sudden change of temperature. This requires a careful balancing of the different elements in the irons, and in many cases the correct amount of manganese will solve the problem. A special iron much heard of lately is semi-steel. The name is a poor one, but like many other poor names, it seems to stick. It is practically not steel at all. It is simply a cast iron strengthened by melting steel with it. It generally gives a foundryman a creepy feeling to melt steel with pig iron, but when he gets up his courage, he finds the metal clean, close-grained and strong and not a bad imitation of air furnace iron. Semi-steel should have a definite composition and its real value is in the low graphite. The plates of graphite scattered through cast iron tend to weaken it, and if the amount of graphite is lessened the iron becomes stronger. Even in running a cupola a chemist may be of value. Cupolas are slagged with limestone or fluorspar as a flux. The amount of limestone is generally given by the chemist. The coke ash should be fluxed as well as the sand on the pig. The old way was to add a shovelful of limestone to every charge of iron, but now from 100 to 200 lb. of limestone are added to a charge, the amount depending on the coke ash and upon the amount of scale and sand on the pig iron and scrap. Lime, if properly used, will absorb some sulphur from the coke and will also save iron from going into the cinder. This may be considered a small point, but it means saving many tons of iron in the course of a year.

But the coke sampling is the most important. Many cokes are sold with 1½ to 2 percent sulphur, which means a moderately low silicon, white iron castings. Sulphur should not go above .75 percent in coke, and many foundrymen find out that the coke is poor after they have made two heats of white castings, then they test the coke. This is much like locking the door after the horse is stolen.

The chemist is often of value to the purchasing agent in keeping up the standard of quality in blackings, flours, core compounds and oils that are often supplied heavily adulterated. Many alloys, fluxes, dopes and physics are constantly pushed on the foundry with a high sounding name. It is usually some familiar compound that is thrust upon him at double the price. Numerous revivors, restorers, are often proposed to make the poorest iron good. Most of these inflated schemes can be punctured by a test in the right place. A careful watching of every part of the work is essential to success and a great deal of this watching may be done by the chemist who tests the supplies and tests the product.

SHOT IRON.

BY P. M. WOODEN.

I have just read in the March issue of *The Foundry* the article on shot iron. My experience with the same began in February, 1904, when I induced my people to put in a "Sly" mill and was able to obtain from my daily drop from 1,200 to 1,800 pounds of shot iron. I used this in each charge during the heat in sufficient quantities to use up each day's shot iron just as it was ground or washed, and then watched and waited to hear from our machine shop, but never heard a word. So the first of last May I induced my people to get another Sly mill and an electric motor and put it to work on my dump, which was one year old.

On the 29th of September I had the dump cleaned up and a little over 118 tons of shot iron to the good and used up into castings. During this time I had also used all of the regular quota from the daily drop. I send all of my gangway riddlings through the Sly mill, and have melted as high as 5,500 pounds of shot iron per day with no evil results, aside from a little extra slag. The cupola is 64 inches and the charge consists of 6,000 pounds of iron on the bed and 3,000 pounds on each charge. I enclose a few shavings planed from one of our saw mill knees, which I picked up as I was coming through the machine shop.

Note by the Editor.—The shavings referred to were evidently from the finishing cut on a planer, with a tool taking a cut about an inch wide. The shavings were rolled up into neat, compact rolls, showing an exceedingly good soft gray iron. From this it is evident that Mr. Wooden has solved the shot iron problem so far as his foundry is concerned.

The Marinette Iron Works, Marinette, Wis., has been purchased by W. O. Carpenter, of Menominee, A. C. Merryman, of Marinette and T. C. Miller, of Chicago.

MAKING OF BY-PRODUCT COKE.*

BY EDWIN A. MOORE.

INTRODUCTORY REMARKS.

By way of introduction Mr. Moore said:

Mr. President, Secretary and Gentlemen: I want to say in prefacing the paper that the president very wisely referred to it as the paper which will be read. When the arrangement was made with me in regard to talking to you about by-product coke plants, etc., I was ill and since recovering have been obliged to get over the country through snow storms and otherwise, and I feel greatly indebted to Mr. D. T. McLeod for preparing most of the detail information (or, in fact, all of it) in connection with this paper.

The opening portion, however, does not make any reference to the introduction into this country of what is properly known as by-product coke ovens, and I know that it would be a matter of interest to all of us Philadelphians who are assembled here—I say us because it was my privilege to be identified with the machine shop and foundry business many years ago, consequently I feel more at home with you than I would otherwise.

So far as my personal knowledge is concerned, the by-product coke oven was introduced into this country about ten years ago through the efforts of Dr. F. Schniewind, of the United Coke & Gas Co., of New York City. He was at that time instrumental in the formation of the Otto Coke & Chemical Co., of Pittsburg, Pa., and is now vice president of the United Coke & Gas Co., of New York City. He induced Mr. William L. Elkins Jr. to become interested in the by-product coke oven and to take up the matter. At about the same time the Solvay Process Co., of Syracuse, N. Y., became interested in the same question and installed a small plant of Semet-Solvay ovens in Syracuse in connection with its soda ash works. By the combined efforts of Dr. Schniewind and Mr. Elkins arrangements were made to build a plant of Otto-Hoffman ovens at the works of the Cambria Steel Co., who had become interested in this question and had sent experts abroad to investigate the matter with a view to making coke at its steel works from coal obtained from its mines nearby. Now the United Coke & Gas Co. and the American Coke & Gas Construction Co., with which I have the honor to be connected, are affiliated with a corporation known as the American Coal Products Co., of which Mr. George W. Elkins (son of the late Mr. Willim L. Elkins) is president. You will see as the paper is read how the by-products are utilized by the American Coal Products Co., particularly as regards tar and ammonia, which result from the carbonization of coal in the by-product ovens. The reason for the introduction of the by-product oven as seen by Mr. William L. Elkins Jr. was largely because of the waste that takes place in carbonizing coal in what are popularly known as the beehive oven, in which the celebrated Connellsville coke is made. As a matter of reality, I guess we get very little of what was originally known as Connellsville coke.

The contrast I wish to bring to your attention is between Connellsville, or beehive, and by-product coke; that which is made in beehive ovens, where all waste products from the coal go into the atmosphere, of which about 30,000,000 tons of coal are carbonized every year. About 20,000,000 tons are carbonized into coke for blast furnace use and the balance for sundry other manufacturing purposes. In this conection we would like to impress upon your mind the fact that there goes off as waste products from this 30,000,000 tons from 80c to $1 per ton. Consequently you can see the advantage of saving these waste products because it is not American-like to see so much waste go into the air. Our friends, the financiers, are usually after the mighty dollar, and they don't like to have it get into the air where they can't get it.

By-product ovens have been in use throughout Germany and other parts of the continent and largely through England, during the past 25 years. There is not anything in the way of a beehive oven in operation in Germany at the present time. Those of you who have been abroad know (I have seen pictures of it) that the by-product coke oven produces all the coke that is used abroad, through Germany particularly, but not so much as yet in England. The introduction into this country was comparatively slow at the first, but the field has greatly increased during the past three or four years. There have been built, or are in course of construction at the present time in the United States and Canada about 3,950 by-product ovens, about 2,605 of these being of the Otto-Hoffman and United-Otto systems, carbonizing approximately 15,000 tons of coal per day and about 1,345 Semet-Solvay, carbonizing approximately 8,000 tons of coal per day,

*Paper read before the Philadelphia Foundrymen's Association, Feb. 1, 1905.

amounting in a year to a total carbonization of approximately 8,400,000 tons. It will thus be seen that, although the number of by-product coke ovens apparently does not approach the number of beehive ovens installed, on account of the difference in the size of the charge and the shorter coking time, the coke made in by-product ovens will be much nearer the total coke tonnage of beehive ovens than would at first be supposed.

Mr. Moore's Paper.

The paper, which was profusely illustrated, was then read by Mr. Moore as follows:

It is not the writer's purpose to discuss the relative merits of the different types of oven, but to describe the method of manufacturing coke and the recovery of the by-products from the coal by means of the Otto-Hoffman system. Let us first discuss the objects of a few of the typical plants which have been built, and the writer will then describe a specific plant.

The first plant built in this country was two batteries of 30 ovens each for the Cambria Steel Co., at Johnstown, Pa., which was mentioned before. In these ovens was coked a low volatile coal from the company's own mines, to produce a coke satisfactory for blast furnace use, and incidentally the recovery of tar and ammonia. On account of the low percentage of volatile matter in this coal, the gas produced was only a little more than sufficient for heating the oven batteries. This plant has been in operation now for approximately ten years and two additions of 100 ovens each have been made at different times. Another plant is that of the New England Gas & Coke Co., at Everett, Mass., consisting of 400 ovens, built for the purpose of manufacturing from Cape Breton coal a coke satisfactory for foundry, locomotive and domestic purposes, but the principal object of the plant was to supply illuminating gas to the City of Boston and the surrounding suburbs; also the recovery of the ammonia in the form of sulphate of ammonia and the tar which is distilled by a coal tar company in the near vicinity of the plant. Another plant is that of the Dominion Iron & Steel Co., Ltd., at Sydney, Cape Breton. This was built for the purpose of manufacturing from Cape Breton coal a coke satisfactory for blast furnace use, the surplus gas to be used in open-hearth furnaces, and the recovery of tar and ammonia. The plant of the Maryland Steel Co., at Sparrows Point, Md., consisting of 200 ovens of the long type, has for its object the manufacture of blast furnace coke, illuminating gas for use in the city of Baltimore, and the recovery of tar and ammonia in the form of either concentrated liquor or sulphate of ammonia.

The above mentioned plants give an idea of the many methods of utilizing the by-products especially the surplus gas and the uses of the coke manufactured by this system. The ammonia produced is usually worked up at the plant into either concentrated ammonia liquor or sulphate of ammonia. The tar is usually disposed of to coal tar companies who distill same, utilizing the pitch for the manufacture of roofing pitch or roofing felt, the heavy or anthracene oils for creosoting, and by the further distillation of the tar separating the various lighter oils for the manufacture of tar oil products. By this method of manufacturing coke the by-products may be recovered and utilized in various ways, as above described, and thus become a source of revenue which will largely reduce the cost of the coke instead of letting all of these products go to waste as in the present manner of manufacturing coke in the beehive ovens.

Many other plants have been built of the Otto-Hoffman system, having many various uses for their products. The writer can best describe the manufacture of coke and the recovery of the by-products by this system by describing the plant of the Camden Coke Co., which is located in Camden, N. J., on the East bank of the Delaware River, near the Kaighn Point ferry. This is a plant which is near at hand and may be visited by the members of this association if they are especially interested.

[At this point the speaker, with a stereopticon, displayed views of a number of coke plants, including those of the Cambria Steel Co. and Camden Coke Co.]

These views will give you an idea of the general appearance and equipment of coke plants both in this country and abroad. The last is a view of the plant which I will now describe.

This plant has for its object the manufacture of coke for metallurgical, foundry and domestic purposes, the use of the surplus gas for illuminating purposes, and the recovery of the ammonia in the form of concentrated ammonia liquor, the tar being disposed of to other parties who distill same for the recovery of its different products. The coke made at this plant during the two years of its operation has been dis-

COKE PLANT OF THE CAMBRIA STEEL CO. AT JOHNSTOWN, PA.

posed of to blast furnaces, foundries, and also very largely for domestic purposes. For the latter purpose, when the coke is discharged from the ovens, it is crushed to various sizes, and at the present time the greater portion of the coke produced is sold to supply the demand for this purpose. The illuminating gas which is made is distributed at about 10 lb. pressure to Trenton, 38 miles away, supplying the intermediate towns between Camden and Tren-

ton, and is used at Camden under ordinary pressure. Entirely satisfactory results have been obtained by this plant, both in the coke produced and the large quantity of illuminating gas made, which very much exceeds the production of most plants of this size on account of the installation of Benzole enrichment, this being a special feature of this plant which will be described later.

The Quality of Coal.

One of the most important things to be determined in connection with a new plant is the coal to be used. This should be a good grade of bituminous coal of from 25 to 32 percent volatile matter and about 68 to 75 percent of carbon. In selecting the coal, the purpose of the coke should be considered in order to get a coal which will make a coke best adapted for the purpose intended, whether for metallurgical, foundry or domestic purposes. The coal should be low in sulphur—not over 1¼ percent for metallurgical purposes—but the lower the better for all purposes, so that washing will not be necessary at the coke plant. If obtained in the form of "run of mine," it must be crushed at the plant to sizes which will pass through a 1½-in. mesh; the finer the better, especially if the coke is for metallurgical purposes, because the fine coal will make a stronger and more uniform structure in the coke, which is better adapted to carry the burden in blast furnaces, and if there is any slate in the coal it is well broken up and more uniformly distributed throughout the mass. The by-product oven permits various grades of coal to be used and also various mixtures to be used. At this plant two or three grades of coal are used to get certain grades of coke and also to obtain a large quantity of illuminating gas. A coal of this class should yield per ton about 70 to 75 percent of coke, 9,000 to 10,000 cu. ft. of gas, 10 gallons of tar, and 5 pounds of ammonia.

The coal for this plant is brought by barge to the docks on which travels an unloading crane which picks up the coal from the barges by means of a clam shell bucket and discharges it, either into the coal storage bin or to the storage pile. The crane has an inclined frame supported on upright frames at either end and travels on a double track on the wharf end and on a single track on a girder at the coal bin end. The crane travels the length of the coal bin and wharf, and both traveling gear and the carriage for the bucket are operated by means of steam engines and boiler mounted on the frame or carriage at the wharf end. At the coal bin end is suspended a steel hopper feeding into a pair of roll crushers operated by electric motors. The bucket is suspended from a carriage which travels up an inclined track attached to the main trusses, and discharges the coal either in the steel hopper to be crushed or into the storage pile, or it takes up the coal from the storage pile and discharges it in the crusher and thence into the bin. It will thus be seen that the crane traveling the entire length of the bin and dock can pick up coal from any part of a barge or storage pile and discharge into any part of the coal bin. This crane has a capacity of 100 tons per hour and the storage pile has a capacity of approximately 8,600 tons. The coal bin is of the Berquist suspension type, carried on two outside rows of columns at a sufficient height above the oven batteries to allow a clear space between same for the charging larry to travel under the bin to be filled from same by spouts connected to the bottom, these being placed at intervals of 12 ft. throughout the length. The bin is constructed of steel and is lined throughout with concrete and expanded metal. It has a capacity of 1,800 tons of coal, which is sufficient for about 3½ days supply for the 100 ovens, which carbonize approximately 500 net tons of coal per day, giving as a result approximately 375 tons of coke, 1,850,000 cu. ft. of 18-candlepower gas, 2,500 pounds of ammonia, and 5,000 gallons of tar. Over the oven batteries are steel trusses extending the entire length; on the lower portion of these a track is placed on which travels the larry for charging the ovens. These trusses have a clear span from the coal bin to supports between the two batteries, and from this point to the further end of the next battery. They are made of steel and are of the usual form of bridge truss. The larry consists of a steel frame mounted on wheels, and from this frame are suspended six steel hoppers with spouts and grates at the bottom of same. The larry is operated by a 15-h. p. motor and travels the entire length of the two batteries and discharges about 6¼ tons of coal into each oven in its regular turn by means of holes in the top of the ovens corresponding to the spouts.

The Oven Batteries.

Let us now describe the oven batteries. These consist of a mass of brickwork supported on a concrete and brick sub-structure. This sub-structure consists of concrete walls on which are built brick arches forming a floor

THE CAMDEN COKE CO.'S PLANT AT CAMDEN, N. J.

or support for the ovens proper. There are 50 ovens in each battery, these being 17 in. wide, 6 ft. 6 in. high and 33 ft. long and are placed 2 ft. 10½ in. on centers. Between each oven is a set of vertical heating flues, directly below same combustion chambers and above same a horizontal flue. Below each oven is an air chamber and below each battery under two of the supporting arches are regenerators running the entire length and connecting at one end

into a common flue to the stack. The openings or ports serve as a passage for the supply of the preheated air from the regenerators to the heating flues, and for the exit of the off-gases from the heating flues to the regenerators. One of these openings is placed directly below each oven. The burners are placed on either side of the battery at the end of the combustion chambers. The gas and air supply for heating the flues is alternated on either side of the battery every half hour, the well-known Siemens regenerative principle being used for the reversal of the gas and air supply.

Let us now follow the manner of heating the ovens, supposing that the gas is burning on the right hand side at the present time. The air supply for the burner is discharged by a fan at the end of the battery into the lower flue of the regenerator on the right hand side, passes up through the openings in the lower arches, through the heated checker brick, through the openings into the air chamber. A damper is placed over each opening which allows the regulation of the air supply to each set of flues. The air passes through the ports in the wall between the air and combustion chambers into the combustion chamber, where it mixes with the burning gas and passes up into the vertical flues (which are divided into two sets midway the length of the oven by a wall extending from the bottom of the chambers to the top of the flues). The burning gases pass from the vertical flues through the upper horizontal flues over the partition wall into and down through the vertical flues on the left hand side into the combustion chamber, through the openings in the wall into the air chamber and down through the opening into the regenerator, giving up a large amount of the heat in passing through the checker work to the lower flue, and thence into the stack. The arrangement of gas burning and the air supply is reversed each half hour by means of valves at the end of each wharf. In this manner the air is always preheated from about 800 degrees Fahr., the temperature of the supply from the fan, to about 1,500 to 1,800 degrees Fahr. when entering the combustion chambers, and the temperature of the off-gases to the stack is reduced to about 600 degrees Fahr. The gas is supplied to the burners from the mains which connect with the regulating gas holder. The heat value of the fuel gas is approximately 550 B. t. u. per cu. ft., and about 6,000 cu. ft. of gas are required per ton of coal carbonized, giving a temperature in the ovens of about 2,500 degrees to 2,800 degrees Fahr. The air supplied by the fan is preheated before entering the regenerators in the following manner:

The air is drawn by the fan through the middle arches of the substructure the entire length of the battery, through openings in the top of each arch into an end chamber from which it passes through the small flues under the chambers the entire length of the battery into a corresponding chamber at the other end, and from this is drawn by means of a pipe into the fan and passed into the regenerator on either side. In this manner the air is heated from the temperature of the atmosphere to about 800 degrees Fahr. before entering the regenerators. By means of preheating the air and the system of regeneration, the maximum efficiency is obtained from the gas burned and higher heats maintained in the ovens than would otherwise be possible.

The Principle Involved.

It might be well at this point to state the principle utilized in the manufacture of coke in by-product ovens. The oven chambers constitute a closed air tight and gas tight chamber heated externally, the heat transmitted from the heating flues to the coal through the brick walls, thereby giving a dry distillation as in a closed retort. By this means the volatile matters in the coal are driven off as the heat further penetrates the charge in the retort, leaving as a residue the coke consisting of 80 to 85 percent of fixed carbon. By means of connections made to each oven the volatile portion of the coal in the form of gas, aqueous vapors, tar oils, and other condensable products are taken off into circular steel pipes, and by passing the same through various apparatus this volatile portion is cooled and the gas washed, obtaining thereby a clean commercial gas, and the condensable portions are recovered in the form of tarry oils, aqueous ammonial liquor, and benzole and its homologues. The principal portions of the oven brickwork, especially those having to withstand the higher heats, are constructed of the higher grades of refractoy clays, the principle of construction being the outgrowth of many years of experience in this line, as a result of which the structures as built at the present time are able to withstand the effects of expansion and contraction due to heating and cooling, and due to varying temperatures in the regenerators and the cooling effect of

THE CAMDEN COKE CO.'S PLANT AT CAMDEN, N. J.

placing a charge of moist coal suddenly in contact with the highly heated oven walls. We have not as yet been able to obtain as good a grade of brick in this country for this construction as are obtained in Germany. This is largely due to the fact that we have not as good clays for their manufacture.

The oven chambers proper, as above stated, are 33 ft. long, 17 in. wide and 6 ft. 6 in. high. They are closed at either end by cast iron, brick-lined doors, which in some cases are luted with clay and in other cases are especially constructed to give a metal joint or seal, thereby doing away with the necessity of clay luting and thus reducing the cost of labor for this work. In any case the ends are air-tight and the coal is charged into these ovens at six points in the length of same and the coal leveled off to a uniform height by means of bars or rods passed through small openings in the doors at the ends. By later improvements in the method the leveling is done by means of an electrically driven ram or bar which travels in and out, thereby cutting down the labor expenses in this connection and giving much more uniform charge.

The entire battery is heated uniformly throughout, means being provided for regulating the amount of gas to each set of flues. The gas driven off from the coal during the first portion of the heating is rich in illuminants and has an average heat value of about 650 B. t. u. This gas, for the first ten to fourtween hours, is taken off into the collecting main through the standpipe, neck and drop valve indicated. At the end of this period the drop valve on this side is closed and the gas for the remainder of the coking period is taken off through the standpipe, neck and drop valve into the main on the opposite side. The gas for this last period is lower in illuminants and has an average heating value of about 525 B. t. u. Its illuminating value will vary with different coals from about 3 to 8 candle power. The illuminating value of the rich gas given off during the first period will vary from 13 to 19 candle power. One set of standpipes and valves are provided for connecting each oven to the gas mains on either side. After the coal has been in one of the ovens for a period varying from 24 to 30 hours, all the volatile matter has been driven off and the charge is ready to be pushed from the oven. At this time the doors are raised on both ends by means of electric hoists which travel on a track directly over the doors on either side, and the charge of coke is pushed from the ovens by means of a ram or bar with a large head. This ram is mounted on a steel frame of the pusher machine and is propelled by means of an electric motor connected through intermediate gearing to a driving pinion which meshes with the rack on the under side of the ram. The ram is driven by a 50-h. p. motor and the machine is traversed lengthwise on a track extending the length of the two batteries by means of a 25-h. p. motor connected by intermediate gearing to the driving shaft of the wheels on each side. After the charge has been pushed out on the coke wharf on the opposite side of the battery, the ram is withdrawn, the doors on both ends are dropped into place by means of the hoist and set hard up against the brickwork by bars and wedges and luted with clay, or in the later improved type of self-sealing doors by means of eccentric bars, and the oven is then ready to receive another charge.

Method of Charging.

It is so arranged that the ovens are charged at regular intervals in the following manner: 1st, No. 1 oven is charged; next, No. 10, No. 20, No. 30, No. 40 and No. 50; then beginning at the other end of the battery with No. 5, No. 15, No. 25, etc. By this manner of charging a more even and uniform heat is maintained throughout the batteries, thus giving a more uniform coking time for each oven. Each oven is pushed in its regular sequence in the manner above mentioned. The coke wharf upon which the coke is pushed consists of a concrete and expanded metal wharf or floor supported on concrete columns and is covered with red brick. After the coke is pushed from the ovens on to this wharf, it is quenched by means of water from a hose, using as little water as possible in order to thoroughly drive out the heat and prevent the coke from burning after discharged into the cars or on to the conveyors.

When quenched it is loaded into steel barrows and discharged into cars from the edge of the wharf, or through holes in the wharf on to the belt conveyor which travels the entire length of both wharves and discharges into the crusher at the ends of the batteries. If the coke is for foundry or metallurgical purposes it is loaded directly into the cars as "run of oven" coke, or it may be divided; the ends and top portion of the charge being discharged on to the conveyor and delivered to the crusher, and the middle portion of the

charge being loaded into the cars for foundry use.

The coke to be crushed is conveyed to the end of the battery, and by means of a cross conveyor, it is conveyed to a roll crusher located at one end of the coal bin. It is run from this crusher up an inclined belt conveyor to the storage bin. At the top of this bin is placed a motor-driven rotary screen 8 ft. diam. x 40 ft. long. The crushed coke is passed by means of a chute into this screen and discharged from the same into five different compartments in the bin, these compartments each having a capacity of 250 tons of coke. By this means the coke is sized and the various sizes, viz.: 2½ in., 2 in., 1½ in., ⅞ in., and breeze, can be loaded from either side of the bin into wagons, cars or barges. It will be noticed that this bin is located on a dock, which allows a barge to come up on either side of the same. In discharging from the bin the coke passes over screens in the chutes, which takes out the dust or breeze; this breeze being used in the boiler house for generating power. Certain sizes, principally nut, are put up in 20-lb. bags which retail at 10 cents. A very extensive trade has been established for this bagged coke, and there is also a large demand for the other sizes for domestic use, the stove and egg size being utilized in furnaces and heaters, and the breeze being used for generating steam in boilers and also for filtration purposes. At the present time nearly the entire output of 375 tons of coke is being disposed of for various domestic purposes; most of this coke is distributed by teams. No doubt most of you are familiar with the ever present advertisements setting forth the manifold advantages of Otto coke and have come to realize that this must indeed be the long-looked-for panacea of all household ills.

We will now return to the volatile portion of the coal, which has been driven off from the ovens and passed through the standpipes and valves into the collecting mains. A certain portion of the heavier condensable products are collected in these collecting mains, the mains being provided with clean-outs where these products, such as heavy pitch form, so that they may be removed; a portion of these products are also taken off by the constant stream of tar which is flushed through the mains in order to keep them clear at all times. These mains run the entire length of the battery and at the ends two pipes, one for the rich gas and one for the poor or lean gas, are run to the condensing plant. During the passage of the gas to the condensing plant a still large portion of the condensable products are recovered, in some cases as high as 50 percent; these consist principally of the heavy tars and oils and some water vapor due to moisture in the coal. On reaching the condensing plant the gas from each main passes through two entirely separate systems of apparatus in being cooled and treated for the further recovery of the products.

Treatment of Gas.

The apparatus on each side is of the same design, and the gas is treated in both sets at this plant in the following manner:

It first passes through the air and water coolers, consisting of a system of rectangular pipes one above the other, connected at the ends by return bends. The gas passes in at the bottom, passes back and forth through each section in a contra direction until it reaches the top and then passes down through a vertical pipe into the common main. These pipes act as air coolers ordinarily, but in warm weather water is sprayed over them from the top and is collected in a cistern below to be cooled and used over again if desired. The gas then passes through circular water coolers, which are 8 ft. in diameter, with 4-in. tubes expanded into heads at either end. The gas passes around the tubes in a downward direction and the water through the tubes in an upward direction, so that the coldest gas is brought in contact with the coldest water, thus obtaining the most efficient cooling results. The cooling in this apparatus should be done gradually and with special care so as to prevent the formation of naphthalene due to a sudden cooling of the gas at any point. The temperature of the gas is reduced in these coolers to about 80 degrees Fahr. and a large portion of the remaining heavier tar oils and the water vapor are recovered; these are led off from the apparatus by drain pipes into a compartment tank where the ammonia liquor, which is mixed with the same, and is separated by gravity to be treated separately. The gas next passes through a tar scrubber which consists of a square tank with a diaphragm plate forming an upper compartment, and the gas entering this compartment passes down through tubes which are set in the diaphragm plate, these tubes sealing at the bottom in a mixture of ammonia liquor and tar. The gas passing down through the tubes has to break through a liquor seal, thereby passing around

the bottom serrated edges of the dip pipes, which gives a cleaning or scrubbing effect for removing the tar. After passing into the chamber around the tubes it is taken off through a connection to the main which connects with the exhausters. Ammonia liquor is fed into the tar scrubbers and the mixture of ammonia liquor and tar obtained in the same is led off to a compartment tank where the liquor and tar are separated by gravity so that they may be treated separately. The gas up to this point has been drawn through the apparatus by a slight pressure in the ovens and by a vacuum created by the exhausters. It now passes through the exhausters which are of the usual type direct connected to horizontal steam engines, and is forced by them under a pressure equal to about 16 or 18 in. of water, through the P. & A. tar extractors which remove the finely divided particles of tar and the lighter oils by passing the gas through circular drums constructed of perforated plates placed closely together; the perforations of the various plates are staggered so that the small streams of gas passing through the perforations impinges on the plates beyond, thereby dropping out the tars and oils. In this machine the gas enters the lower chamber, passes up into the drum of perforated plates, through the same into the upper chamber and out into a connecting main. These drums seal in a mixture of ammonia liquor and tar and a greater or lesser amount of perforated surface is exposed, depending on that required to remove the tar and oils. This apparatus can be set for a certain differential pressure necessary to remove the tar, and is self-regulated at this pressure by means of counter-weights.

Removal of Ammonia.

The next step of treating the gas is the removal of the ammonia. The ammonia is removed from the gas to the best advantage at a temperature ranging between 60 degrees and 75 degrees Fahr. It is, therefore, the object to have the gas at about this temperature when entering the ammonia washers. This enables the ammonia to be removed with the least amount of water or weak liquor which is used for the washing purposes, thereby making a stronger liquor to be treated later on in the ammonia house for the conversion of this liquor into a finished product. The ammonia washers consist of circular shells, 8 in. in diameter, with a bottom and top compartment, and intervening spaces between the same filled with perforated plates or with wooden slats set at right angles to each other, attaining by both of these means the breaking up of the gas into small streams and forming a large area of wetted surface for contact with the gas, whereby the ammonia can be most readily removed. Two of these apparatuses are used on each side, the gas passing through them in series. In the washer furthest from the exhausters a large portion of the ammonia being already extracted from the gas in the first washer, it is washed by clean cold water, this water being fed into the washers by means of a number of sprays set in the top of same. The gas passes up through the washer and the water down through the same removing the last traces of ammonia from the gas and resulting in a weak ammonia liquor which is drained to a compartment tank and pumped from there to the overhead feed tank, from where it is fed into the first washer. Here it washes the gas which contains a greater amount of ammonia, and by washing with this weak liquor a large percentage of the ammonia is removed and the liquor greatly increased in strength. This liquor constitutes what is called the strong liquor which is about 1 percent to 2 percent in strength, and the manner in which this liquor is treated will be described later on in connection with the ammonia house.

As the poor gas is used only for heating purposes, the illuminants in same (which are principally benzole and its homologues), are practically of no value, and in order to utilize these illuminants to the greatest advantage the poor gas is now passed through three washers of a type similar to the ammonia washer, and in passing through these in series the gas is washed by tar oil which has a strong affinity for benzole and removes from this gas the greater percentage of same. This tar oil, after passing in series through the three different washers, thereby increasing the amount of benzole in the same, is then pumped to the benzole house where it is treated in a manner to be described later on. The poor gas after leaving the benzole washers passes to the regulating gas holder maintaining about 7 in. water pressure, and from there to the batteries where it is used for heating purposes.

The rich gas after being washed in the ammonia washers passes out of the condensing house and to the storage holder. In order, however, to increase the illuminating value of this gas by utilizing the benzole removed from the poor gas, a small portion of the rich gas

is taken at a point beyond the ammonia washers by means of a pipe, through a gas compressor, passed to the benzole house and through one of the benzole stills, in which the tar oil previously mentioned is being treated. The tar oil from the benzole washers, in passing down through these stills which are heated with steam gives up the benzole (which is evaporated by means of heat) and the rich gas in passing upward through this still takes up these benzole vapors. The current of rich gas is then passed back into the rich system in front of the exhausters in the condensing house, is mixed with the larger volume of gas in these mains and thereby increases the candle power of the whole quantity. In this manner a much greater illuminating value is obtained from the coal, and the high candle power rich gas when later on mixed with water gas from an auxiliary plant requires less enrichment in order to get a mixed water and coal gas of a high candle power. Water gas is only made at times when more gas is required than can be supplied from the coke plant. This gas is made in a standard Lowe apparatus. This is one of the first instances where this method of benzole enrichment has been used in this country, it being done here, we believe, on a larger scale than has ever before been attempted, and it has demonstrated its value in this plant to the thorough satisfaction of all parties concerned.

Condensable Products Removed.

The condensable products in the gas are finally removed from the various apparatus and piping in the condensing house by drains to separate compartment tanks. The strongest ammonia liquor, which will vary from 1 percent to 2 percent, is pumped to a feed tank in the ammonia house, and the lighter tars obtained in this apparatus are pumped to the tar storage tanks. The heavier tars which are condensed in the gas mains between the ovens and the condensing house are drained into large tanks or pits and a portion of this tar is pumped over and over through the collecting mains on the battery. The balance of the tar is pumped to the tar storage tanks and is loaded from this tank into barges for treatment at the works of the coal tar products people. The picture before you is that of a large condensing plant with apparatus similar to that described. It forms a part of the coke plant of the Lackawanna Steel Co., Buffalo, N. Y., and is designed to treat 33,000,000 cu. ft. of gas per 24 hours. It is undoubtedly one of the largest single plants of its kind in the world. The ammonia liquor is fed from the overhead feed tank in the ammonia house into circular stills. These stills consist of three parts, a volatile still and a lime mixing chamber, which parts comprise one unit, and the fixed ammonia still, which comprises a separate unit. The liquor passing in at the top of the volatile still is preheated and as it passes down through the upper portion of the volatile still the volatile ammonia is freed by contact with steam and hot ammonia vapors from below and the liquor flowing into the chamber below is mixed with milk of lime and agitated by compressed air to give a thorough mixture. The liquor and lime passing from this chamber into the lime still, comes into further contact with steam, thereby setting free the fixed ammonia. The waste liquor passes out of the bottom of the lime still into the drain. These stills handle approximately 30,000 gallons of 1¼ percent liquor per day, reducing the strength of the ammonia in the waste to a minimum. The vapor which is given off from the still passes into a circular apparatus 4 ft. in diameter, consisting of alternating absorbing and water-cooled sections. In this apparatus the gas passes down through the ammonia liquor in the various sections, this liquor constantly overflowing and increasing in strength as it reaches the bottom. It is also brought in contact with water-cooled surfaces, thereby reducing the temperature and increasing the strength to a greater degree. In this apparatus the strength of the liquor is increased to about 16 percent to 20 percent, which is a commercial product used for various purposes.

In some plants the ammonia gas from the stills is brought in contact with sulphuric acid in large lead-lined boxes, thereby forming a precipitate or salt, which is called sulphate of ammonia. This salt is then drained from the boxes and passed through a centrifugal drying machine whereby the moisture is removed and the salt sold for use as a fertilizer. The farmers are being educated to its use at the present time through the Department of Agriculture and, as the country grows and people become more educated in scientific farming, sulphate of ammonia will be used more and more as a fertilizer.

How Power is Supplied.

The power required for the different apparatus and machinery throughout the plant is supplied by electric power generated in the

power house, using for the purpose coke breeze in the boilers and a portion of the poor gas in gas engines. The power plant consists of three sets of water tube boilers, 256 h. p. each, these boilers being equipped with a forced draft system and special grates for burning coke breeze. The boiler fronts are also provided with connections so that gas may be used for fuel if desired. Especially efficient results have been obtained by the use of the forced draft system in burning coke breeze, the boilers showing by a test conducted under ordinary working conditions that they were developing 389 h. p. each, or more than 50 percent above the rated capacity without showing especially deteriorating results. These boilers are connected by a breeching to a stack which is common both to the boiler house and the ovens. This stack is of special perforated brick, and is 7 ft. in diameter by 150 ft. high. The boiler is provided with the necessary feed pumps, injectors and other customary fittings. The bulk of the steam generated here is used for a Green engine of about 150 h. p., for the exhauster engines in the condensing house and for the stills in the ammonia house. In the engine room are placed the Green engine which is used under ordinary conditions for developing electric power required, this engine being belted to a 180-k. w., 220-volt, alternating current generator, which is placed on a line shaft. This generator furnishes ordinarily sufficient power for the entire plant and is seldom used up to its capacity except momentarily. There is also a 280-k. w., 220-volt, alternating current generator direct connected to a Westinghouse gas engine. This gas engine is used ordinarily as a reserve, but at intervals, when sufficient fuel gas is available, it has been operated by this gas with entirely satisfactory results. Notwithstanding the fact that this gas is unpurified, it is only necessary at intervals to place clean igniters, which is the only difficulty experienced with the use of same. It was the original intention to use this engine for the regular supply of power, but owing to the fact that the amount of fuel gas has been reduced in order to increase the quantity of illuminating gas, it has been unable to carry out the original intentions, except at intervals. On account of the benzole obtained from the poor gas, it has been found desirable to run the ovens longer on the rich gas side, thus getting a greater quantity of illuminating gas, but at a lower average candle power. This candle power, however, has been increased to that desired by the use of the benzole enrichment. This plant is, we believe, one of the few in this vicinity which is using alternating current for power purposes, especially on apparatus where any variation in speed of the motors is desired; it has, however, proven very satisfactory. The power plant is provided with the necessary generator and feed panels complete with the customary fittings for this purpose. The lighting for the plant is supplied by an outside circuit, incandescent lights being used throughout, these being enclosed incandescents in certain portions of the plant, particularly in the benzole house.

In regard to the benzole plant, we believe it unnecessary to further describe this, as it would take the writer into considerable amount of detail, which would not be particularly interesting to you, and the principal object of the benzole plant was described earlier in connection with enriching the rich gas.

The Water Supply.

This plant has its own water supply consisting of a steel standpipe, 10 ft. in diameter by 100 ft. high, and two horizontal duplex steam pumps with a capacity of 1,200,000 gals. per day. The pumps draw the water by a suction line from the Delaware river, the foot-valves and strainer being placed in a cribbing in the dock on which the coke storage bin is situated. The water is distributed at approximately 40 lbs. pressure throughout a system which supplies the fire service lines, water for cooling apparatus, coke quenching, ammonia washing and various other purposes. This makes the plant entirely independent of the city service except for drinking water, and greatly reduces the cost of the supply. The office is placed near the entrance to the plant for the superintendent and necessary clerical force. All tests and analyses in connection with coal, coke, gas, tar, and ammonia products are made by a chemist, in a laboratory situated adjacent to the power plant. The duties of the chemist in these plants are important, as it is only by chemical analyses of the gas and liquors that wastes due to careless operation are detected. It is also his duty to analyze the coal, coke and tar and watch the operation of the condensing, ammonia and benzole plants. The heating and operation of the ovens also materially influence the quantity of the by-products produced.

The above description of this plant covers the principal and most salient features in connection with same, and the writer will be

pleased to go into any further detail questions if information is desired by any of the members, or an opportunity will be given to any of the members of this association to visit this plant if they desire, especially to examine the coke, which is, I believe, the product most interesting to you.

Many improvements have been made in the design and construction of later plants, some of the principal features being as follows:

In connection with the oven construction, several plants have been built in which the length of the ovens has been increased from 33 ft. to 43 ft., thus increasing the capacity of the ovens to nine tons or approximately 30 percent at a very small cost, the principal increase in cost being ten additional feet of brickwork with the necessary increased foundations, and a slightly larger pusher machine on account of the longer bar required, and a larger coal larry, thus obtaining a much larger output at a slight increase in investment. While the average charge of the ovens at Camden is 6¼ tons, this charge has been increased in later ovens of the same length to 7 net tons. This has been done by increasing the height of the ovens 6 in., and by the introduction of a leveling machine which enables coal to be leveled more uniformly than is done at this plant by hand.

The oven proper is at present built on steel beams supported on three concrete walls running the entire length of the battery. The regenerators are built underneath and are made entirely separate from the oven proper, a connection between the regenerators and the ovens being made by a connecting brick flue at each three ovens. This construction prevents the possibility of cracks developing in the ends of the ovens due to the contraction and expansion of the regenerator brickwork. One of the principal objects of this construction is, however, to reduce the cost and to enable the introduction of auxiliary burners at different points in the combustion chambers, whereas in the type of oven at Camden only one burner is used at the end of the battery. The multiple burner system enables a little more uniform heat being maintained through the length of the oven so that the charge will be more evenly coked. The coke wharf at this plant has been replaced in later plants by a coke quenching machine. This machine consists of a water-cooled chamber approximately the size of the ovens, mounted on a steel frame. This chamber is made up with hollow side castings and circular top and bottom castings. The water is introduced into the bottom section, passes up through the sides and overflows at the top of the side sections, thereby coming in contact with the coke and quenching same with a minimum quantity of water. The steam evolved acts as a dryer and the surplus steam at the beginning of the operation passes out through stacks or pipes on top of the chamber. A heavy chain forms the bottom of the chamber, and this chain travels through same, passing under the bottom of the machine in its travel.

Method of Operation.

The method of operation is as follows: When the oven is ready to push, the machine is moved opposite the oven, the pusher ram pushes the charge of coke into the chamber, the doors on either end of the chamber are closed, and the water which is drawn from a trench running the entire length of the quencher track is discharged by a motor-driven centrifugal pump into the bottom portion of the machine, quenching in the manner above mentioned. After the coke is quenched the doors on either end are raised and the motor operating the chain is started. The chain carries the coke charge out of the chamber into cars at the end of same. By this method of discharge, the machine can travel along a series of cars throwing the ends of the charge in one car and the middle portion into another, or in case of an under-coked charge the entire charge may be distributed over a series of cars. In this manner a selection of coke may be made and the coke handled with a minimum amount of labor. On account of the steam acting as a dryer, if the quenching is properly done, the moisture will run from 3 to 7 percent when discharged into the cars. As the coke is not broken until discharged into the cars, the amount of breeze is also greatly reduced from 5 percent to practically nothing. This method of quenching gives the coke the grey metallic lustre which is to many foundrymen the indication of a first-class coke, but which is really no indication as far as actual results are concerned.

The above improvements are only a few of the many which have been made during the past few years with a view of simplifying the construction, reducing the cost of same, and particularly reducing the cost of labor by using machinery wherever advantageous. This all tends to reduce the cost per ton of coke made, which, of course, is one of the principal points to be attained. We feel very much encouraged

by the many uses to which this coke is applied and especially at the accounts received from the foundrymen and furnace men using same, and at the increasing interest they are manifesting in it. We feel sure that if you will all give it a trial you will be amply justified by the results.

During the past few years the installation of these plants have received a great impetus over the preceding years since its introduction in this country. We, who firmly believe in the field open for these plants for the various objects, believe that in the next few years the number of beehive ovens built will be materially reduced and that the by-product oven will eventually replace the beehive oven. We feel justified in this belief because it will sooner or later be necessary, as competition becomes more severe, for manufacturers in this country to reduce to a minimum all waste products, as has already been largely done abroad, thereby reducing the cost of manufactures in every line.

The writer feels that he has not done full justice to this subject, owing to the fact that business demands have made it impossible, in the brief time allowed for preparation, to treat the subject in a more than a superficial manner, and he feels certain that further investigation on your part will convert you into advocates of this method of making coke rather than by the other method, whereby only about 63 percent of coke is obtained from the original coal, as in beehive ovens, instead of 70 percent to 75 percent coke and the by-products, as are obtained in the by-product ovens. I hope to have the opportunity at some future time to present to you more detailed and interesting data on this subject, and wish to thank you all for your kind attention to what must have seemed to many of you a lengthy and uninteresting discussion, as the subject must have been entirely new to some of you.

The Archer Iron Works, of Chicago, Ill., are sending out a 24-page catalogue illustrating and describing their steel wheelbarrows and various types of charging barrels, cars and trucks for use in connection with industrial plants and especially about foundries.

CORE ROOM RECORDS.

By R. W. MacDowell.

Many foundries do not pay sufficient attention to the running of accurate cost records for their core rooms. No exact records are attempted, and it is not known just how many cores are made, nor how many are lost through poor work in the making or through carelessness. The result as that they have little or no idea as to whether this department is costing too much, or how to make it cost less. Carelessness in this respect also breeds indifference on the part of the coremakers, who know that there is no record of their work that can be depended upon. A good cost system in this department will go far toward showing where the leaks are, and will give something definite to proceed on in the effort to stop them. No matter how big or how little a foundry may be, a system of this kind should be carefully kept, for if the cost of the cores be not known, it stands to reason that the cost of the castings cannot be determined with any accuracy. Naturally, the make-up of the sys-

Report of Material used in Core Room

Date_____ Rept. No._____

I have today used the following material in core dept.

Sand	lbs.
Sand	lbs.
Linseed Oil	gals.
Core Compound	gals.

Form 1 Foreman.

The Foundry

Requisition For Supplies. No._____

To_____ Date_____

Storekeeper

Please furnish_____ Dept. with the following material.

Form 2 Foreman

The Foundry

tem must be determined by the kind of a foundry it is intended for, and what style of castings are to be manufactured, some kinds of work requiring many cores, while other kinds require but few, but in any case, the cost of the cores, by the month or by the job, should be at hand at all times.

It is not really a difficult matter to operate a system of this kind. The principal items in any cost system are material and labor, and there should be no trouble experienced in keeping track of these, as no complications are likely to arise in accounting for either, the material being simple and easily weighed or measured, and the labor being principally piece work. A little care and attention in reporting the amount of material used and the number of cores produced by each man will be all that is required. The core room should be treated as a separate department and charged with the material and labor expended in producing the cores as well as its proportion of general expense, and should be credited with the good cores which it produces. Let a ledger account be run with this department, and the charges and credits be entered monthly.

The core department of a radiator plant forms a good illustration on which to base a system of this kind, for this is all cored work, the core room being a very important part of the foundry, and all the large radiator plants are extremely careful to get exact figures as to the cost of operation of their core rooms. We will therefore describe a method of keeping records for a plant of this kind which makes single, two and three column radiators.

Material.

All material used in the making of cores is charged to the core department account once or twice per month, as preferred, or may, if it is so desired, be charged direct at the time the invoice comes in, the former method being probably the better. Sand, linseed oil, core compound and other materials used in large quantities, are kept either in the core room itself, or in close proximity to it. Other supplies which are used in smaller quantities, such as carbon oil, rosin, flour, molasses, etc., are kept in the store room and given out on requisitions issued by the foreman of the core room as he requires supplies of this character from time to time. As the material kept in the core room is used, it is reported to the storekeeper, or whoever has charge of the store records, by means of blanks like Form 1. This is a simple form, giving the quantities of the different kinds of sand, linseed oil, core compound, etc., and the number of batches of sand mixed.

There is no trouble in determining the exact quantity of linseed oil and core compound used, as a gallon or two gallon bucket can be used to get the oil out of the barrel. A blackboard is kept in the core room, on which the record

COREMAKERS TIME CARD

Name _____ No. _____

Mark _____

Kind of Core	Made	Disct	Good
Single Column			
20" Steam			
26" "			
32" "			
20" Water			
26" "			
32" "			
Two Column			
20" Steam			
26" "			
32" "			
38"			
45"			
20" Water			
26" "			
32" "			
38" "			
45" "			
Three Column			
20" Steam			
26" "			
32" "			
38" "			
45" "			
20" Water			
26" "			
32" "			
38" "			
45" "			
Special			
O.K.			

Form 3

The Foundry

can be kept until the report is made up for the day. The quantity of sand used may be ascertained in various ways. Certain sizes of wheelbarrows may be used, by which the quantity may be readily approximated, or each load may be weighed. This latter method is not recommended as it is slow, and frequently the sand mixer will forget to note the weight of

Report of Cores Made During _____ 190____

	Steam						Water				
	20″	26″	32″	38″	45″	No. Col.	20″	26″	32″	38″	45″
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
29											
30											
31											

Form 4

The Foundry

one or more loads. One of the best methods the writer has ever seen employed was in a plant having tracks run from the core room to the sand sheds, over the scales, and using a

Cores Discounted on _____ 190____

Thrown out

Number	Size	No. Col.	Kind	Cause

Broken

Number	Size	No. Col.	Kind	Cause

_____
Foreman

Form 5

The Foundry

sheet iron lined box in which to mix the sand. This box was mounted on wheels, so when a batch of sand was required, the whole box was taken to the sand sheds, filled with sand, and weighed on the return trip. The weight was noted on the board as soon as the sand came in, so at the end of the day the board will show just how much sand has been used. If the sand is mixed by means of one or more of the machines now in common use, the same plan may be employed, by using large boxes in which to bring in the sand and weighing each load in the same way. This method will probably give better results than almost any other way.

Core Room Records.

Requisitions, Form 2, are made out in duplicate, one copy going to the storekeeper while the other copy is retained by the core room foreman for checking purposes. The requisitions from the core room should be of a different color from those of the other departments, for convenience in making up the monthly reports. A card will answer very well for the foreman's copy, as in this shape it is convenient for filing. There will not be any very large number of these requisitions issued in the present instance, as radiator cores are nearly always made of sand and linseed oil instead of sand and flour or sand and molasses, and the

REPORT OF MATERIAL USED IN CORE ROOM FOR MONTH OF _____ 190

Material	Price	Cost	Remarks
____ lbs. Sand			
____ lbs. Sand			
____ gals. Linseed Oil			
____ gals. Linseed Oil			
____ gals. Core Compound			
____ gals. Core Compound			
____ gals. Molasses			
____ lbs. Rosin			
____ lbs. Flour			
____ qts. Carbon Oil			
____ ft. gas for ovens			
____ batches Sand mixed.			
Cost of Material			

Form 7

The Foundry

linseed oil is kept in the core room itself and reported on the daily report.

In this way the material used is accurately reported, and there is no reason whatever why this item need ever get wrong. The next feature to be considered is,

Labor and Production.

Labor in the core room is an extremely simple matter to take care of, cores being paid for at a certain rate each, which gives a fixed price on productive labor, all non-productive labor being paid for by the day. Time is registered by means of a clock, every workman being provided with a card on which he registers his time of beginning and quitting work, whether he works by the day or by the piece. The cards of the men in the core department are of a different color from those of the other departments which makes it easier to enter up the time in the proper place.

In addition to these cards, the coremakers each make out a card like Form 3 after their work is finished for the day. These cards are turned in to the office after the foreman has O. K.'d them, and from these cards the monthly core sheet, Form 4, is made up. This sheet is ruled so as to provide spaces for the various kinds of cores used, and is a very useful record to have about a radiator works, as it can easily be seen from month to month just what has been done and what has been received in return for the outlay as shown by the monthly recapitulation. In many foundries, a record of this kind would not be necessary, but in a radiator plant it is well to have this information at hand at all times.

A discount sheet, Form 5, is also kept, on which the number of cores thrown out each day is recorded. A core may be broken through carelessness on the part of the coremaker, it may have imperfect vents and cause a "blow" or the knobs upon it may be defective. In any of these cases, the coremaker receives no pay for it. If, however, as is sometimes the case, the core is broken by the molder through no fault of the coremaker, the latter is paid for it, the discount coming off the molder. After this system has been worked for a little while, it is surprising to note the effect it has on both coremakers and molders,

LOCATION

MINIMUM UNIT FLOOR

NORMAL ROOM SECTION BIN OR SHELF

REMARKS NO.

Received			Delivered			Delivered			Balance		
DATE	ORDER NO.	QUANTITY	DATE	ORDER NO.	QUANTITY	DATE	ORDER NO.	QUANTITY	DATE	QUANTITY	COST

Form 6

The Foundry

Core Room Report for Month of _____ 190____

Cost of Material						
Cost of Fuel						
Cost of Labor (Productive)						
Cost of Labor (Non-Productive)						
Total						
% Genl. Expense						
Whole Cost						
No. Cores Made						
No. Discounted						
Total Good Cores						
Average Cost						

Form 8

The Foundry

making them far more careful in the manufacture of the cores and the handling of them after they are made, and it will be found that a very small percentage will be either carelessly made or broken. The discount sheet shows what kind of core was thrown out, who made it, why it was rejected, and where the fault lay, which is all the information the management needs. The time cards have a space given on them for rejected cores, so the number of good cores produced by each coremaker is easy to figure, and this is all that is necessary to enter in the time book, radiator cores being paid for at a certain rate, each according to their size, this rate varying from ½c to 1½c each. If one man works on two or more different kinds of cores during the period, ample space will be found in the "total" column to note the number made of each kind.

A certain section of the pay roll book is allowed for the core department and the productive and non-productive labor is usually run on different pages, so there is no difficulty in getting each of these amounts for the month, pays being twice per month. The non-productive labor consists principally of the men who look after the oven, take out the cores and put them in, the sand mixers, and the boys who grease corepans, go after wires and help the coremakers in various ways.

The Monthly Report.

The monthly core room report is simply a recapitulation of the other forms. The cost of the material is first given, followed by the cost of fuel, productive and non-productive labor, and the percentage of general expense. The cost of the material is obtained by taking the amounts used from the stock records and the requisitions and extending the value at the price per pound or gallon. The stock record has been previously described in this magazine so description will not be necessary. A form, (No. 6) is, however, shown for the purpose of illustration. The total material issued on requisitions is figured up and entered in the same way, thus giving the entire cost of the material for the month.

The productive and non-productive labor is then gotten from the time book, by adding these items as shown on their respective pages for the two preceding pays. The number of cores made is then gotten from the core sheet, and if desired, the average cost each can be figured. This will not, of course, be strictly accurate, owing to the difference in the sizes of the cores, but it will not be far out of the way, and if the difference in the prices paid is added or deducted as required, the variation will be very trifling.

These reports are then filed and form a permanent record. It is thus possible to make monthly comparisons, and if the core room is costing more this month than it was last month, or if the work is not coming fast enough, it will be seen at once, and there will be something to proceed on toward finding out the reason; if there is a leak anywhere the reports will show it and aid in finding where it is. Without such a system of records it is the easiest thing in the world for unnecessary

cost and leaks to go on for months unchecked, and even after they are discovered it is one of the hardest things to find just where they are and check them if there is no such data at hand as these reports provide. Of course the system will not attend to such matters itself alone, but if common sense is used in connection with them, they will be found to be of the greatest assistance. The core room of every foundry is not, of course, as important a department as it is in a radiator plant, but it is important nevertheless, and it is well to bear in mind at all times in regard to foundry work of any description that "What is worth doing is worth making a record of."

SOME MELTING FURNACE PRACTICE.

The Steele-Harvey melting furnace which was described in our issue of August, 1904, has been installed in a good many different plants, and we have received the following information concerning some tests made in one of these furnaces. It will be remembered that this is a furnace in which a crucible is surrounded by a tilting furnace and heated by gas or oil, the result being that the metal is not brought in contact with the products of combustion to such a great extent as it is in many melting furnaces. The makers claim that this results in much less loss and in a better quality of metal. The results given also show that it is possible to melt very refractory material in the furnace. This furnace is made by the Monarch Engineering and Mfg. Co., Baltimore, Md.

In a test made at a prominent foundry near Baltimore, the following results were obtained in one of the large No. 275 furnaces, the composition being of heavy copper and red metal.

First day's run 2,895 lb.; loss 1.04 percent; number of heats, 4.

Second day's run 2,252 lb.; loss 1.19 percent; number of heats, 3.

Third day's run 2,579 lb.; loss 0.96 percent; number of heats, 4.

Fourth day's run 2.534 lb.; loss 1.03 percent; number of heats, 3.

Average use of oil 1½ gallons per 100 lb. of metal, and castings were run into a fine grade of marine work.

At the same plant the following test was made in the same furnace:

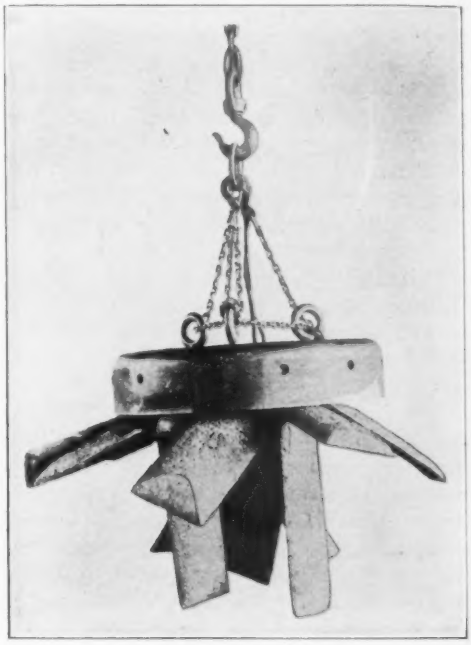
175 lb. low carbon billet steel.
24 lb. ferro manganese.
4½ lb. ferro silicon.

The above was run into a fine grade gear wheel, and time of melting was three hours, oil consumed two gallons per 100 lb. of metal.

The following test of foundry iron was made: 590 lb. No. 2 put in received 571 lb., loss in slag and dross 19 lb., oil consumed three gallons per 100 lb. metal.

LIFTING MAGNETS.

With the increased tonnage of many of our larger plants and the increased competition, it becomes necessary to practice every possible economy in the handling of material. This has led to the adoption of many devices for handling material in bulk. One of the most interesting applications in this line is the use



A LIFTING MAGNET.

of electrically operated lifting magnets, for handling such material as pig iron, scrap, castings, etc. These have for some time been successfully used for handling plates, bars and billets, but they are equally advantageous in the handling of material in bulk.

The accompanying illustration shows one of these magnets lifting a quantity of sandless pig. It can be used equally well for handling many classes of castings, scrap, etc.

One point that has been discovered in the application of these magnets, however, is that a single design of magnet is not adapted for handling all classes of material. Each magnet

must be designed for the work it has to do. For instance, it requires a very different magnete for the handling of thin plates from that which would be required for the handling of steel billets. The manufacturers have taken great pains to design each magnet so that it would be especially suited for the class of work which it has to perform.

The magnets are controlled by the crane operator, so that in handling pig iron and other similar material, the man in the crane can do all of the work without any help from some one on the ground. Pig iron can be loaded into or taken from cars, or handled in a number of other ways by this device. The manufacturers state that while one might think at first that there was great danger of accidents in this method of handling, that they have a large number of magnets in use at different places throughout the country, and they have yet to learn of a single accident that has occurred through their use. In fact, the records for the magnets are very much above those for ordinary sling chains used for handling certain classes of material. The magnets when built are tested with from four to five times the specified load.

These magnets are made by the Electric Controller & Supply Co., of Cleveland, O., and are protected by the Wellman, Clark and Peik patents.

FOAMING SLAG.

Seeing an article in *The Foundry* on foaming slag, I thought I would give my experience with the enemy of the casting. I had been melting 12 to 15 tons a day; all was going well until I got a new car of coke. Our first heat was small, eight tons, the next day 14 tons was our heat. The slag began about the middle of the heat to foam and stopped up the slag hole. I went up to the charging floor and found the melter charging on iron which disappeared through the slag which was now up to the charging door. I stopped the charging and as I found I was having trouble with my motor driving the wind through the cupola as my heat was near off and the slag began to get into the tweers and wind drum; I told the melter to pull the bottom but before he could my motor stopped with a fuse blown. Now that slag which was up to the charging door found its way into the tuyeres and wind drum of the cupola in along the wind pipe for 20 ft. I had a solid mass of slag that looks like a black glass. It was very heavy and could not be broken easy.

We lost a day getting the cupola ready for the next heat. I changed my coke, which, to all appearances, looked no different, yet results proved it was in the coke, as the iron was the same for a month. The cupola lining was a month old and our next heat was all right and has been ever since.

Can some one tell me if this slag was from the coke which I believe it was. Why is it so heavy and so solid?

MATTHEW ELLIOTT.

FOAMING SLAG.

BY EDW. HANDLEY.

An analysis of your foaming slag will show it to be principally a basic silicate of iron.

When the bed in the cupola becomes too low, caused either by economy in coke or by using a soft coke with excessive blast, which will allow melting to take place too close to the tuyers and thus allow the blast to play directly upon the melting iron, oxidation of iron, to a certain extent, will invariably take place. It is a well known fact that atmospheric oxygen unites with iron at a white heat, and when oxygen and iron unite under these conditions there is a decided raise in temperature, which of course has a tendency to promote further oxidation.

The oxide of iron being a strong base, readily attacks the acid lining of the cupola, which creates the excess of slag, and also accounts for the burning out of the melting zone.

The melting of the iron frame extending out at the charging door does not mean anything, as that can happen when the cupola is running all right by leaving the blast on too long after the last charge has been melted down.

In conclusion, let me say, keep your bed high, don't use too much blast, watch soft coke carefully and you will have no trouble with foaming slag.

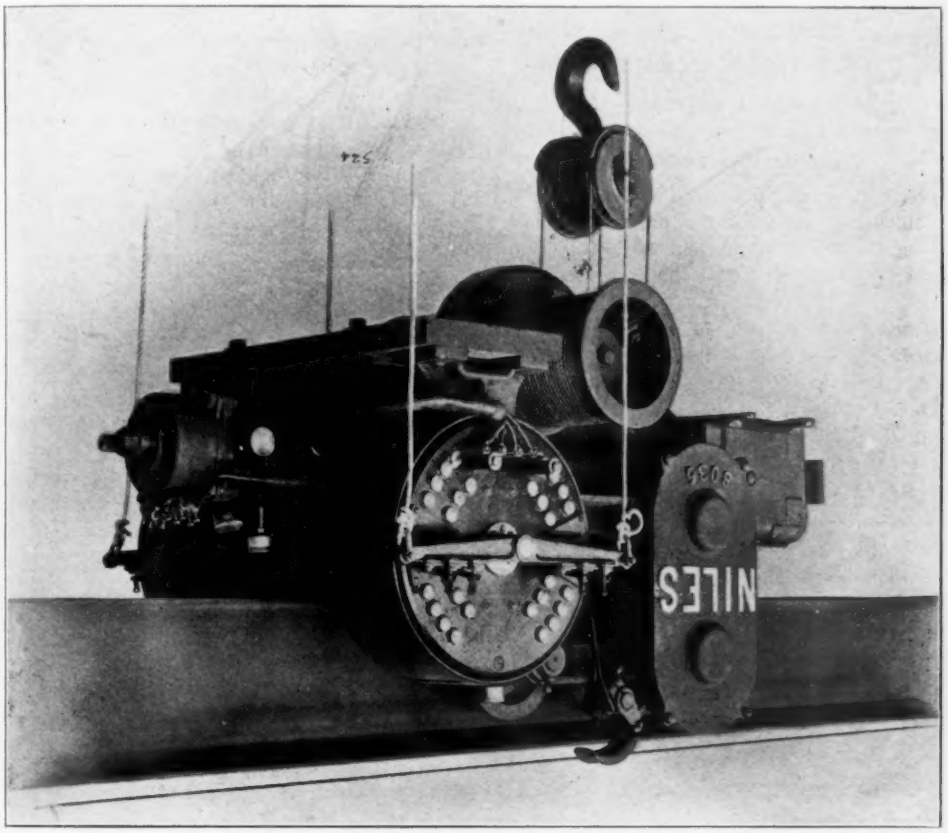
A NEW TRAVELING ELECTRIC HOIST.

Electric traveling hoists have many advantages for different classes of work and especially for foundry work. By arranging suitable switches and passing points, it is possible to reach any point on the floor, and for instance, in pouring operations, to have a steady procession of ladles moving from the cupola to various parts of the floor and back again without interfering with one another, while when ordinary traveling cranes are used they are constantly getting in each other's way.

A new electric hoist suitable for foundry

use is shown in the accompanying illustration. It is arranged to run on the lower flange of an I beam, and is built in capacities from ¾ up to 6 tons. For broad spans such traveling crane hoists are arranged to run between two I beams. The controllers are attached to the hoist and operate it by cords reaching to the floor. These hoists will run on either curved or straight tracks and are usually provided with separate motors, one for traversing and the other for hoisting, though when desired a hand traverse can be supplied. The hoist is self-contained and arranged so that it is balanced when in use.

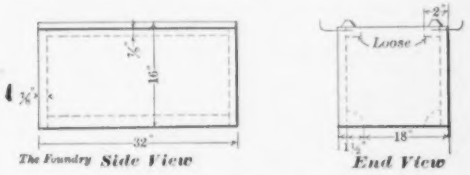
These hoists are manufactured by the Niles-Bement-Pond Co., Liberty street, New York, N. Y.



A NEW TRAVELING ELECTRIC HOIST.

TROUBLE WITH THE FOUNDRYMAN.

I enclose two views of a pattern which I made and the foundryman claims he could not mold it. It will be seen by the views that it is a simple square pattern with two strips top and bottom. The top strips are left loose and



are held in place with wires. The foundryman sent back word that he could not mold it, that it would have to be cored out inside, and I can't see why that foundryman couldn't have molded the pattern in a three part flask. There was a great rush for the casting and the trouble made a great delay as there was only one casting wanted from the pattern. I would like to hear from some of the readers in regard to this pattern. C. E. W.

J. P. Raymond, of Oswego, N. Y., is planning to build a new foundry at Red Creek, N. Y.

METALS IN FOUNDRY PRACTICE.

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Steel, Brass and Bronze.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.
J. B. Nau, Metallurgy of Steel and Steel Castings.
Dr. Richard Moldenke, Malleable Castings.
C. Vickers, Brass Castings.

We have also made arrangements with several others to act as special contributors upon Brass, Bronze and other subjects. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

Silicon and Carbon.

Question.—In mixing iron I understand that the silicon is used for the purpose of controlling the carbon; what should be the ratio between the graphitic and the combined carbon?

Answer.—Silicon is used to vary the ratio between graphite and combined carbon, and it is the only practical way to do this, but there are many other ratios between the other elements that influence the quality of castings, therefore no definite percentage of silicon, graphite or of combined carbon can be depended upon to produce a definite quality of casting. Two castings with absolutely the same chemical composition, so far as the six ordinary elements are concerned, may have quite different physical qualities.

However, the only way that we have to vary physical quality is to vary silicon, and then we measure the shrinkage and strength to see if more or less silicon should be used with that mixture.

Ordinarily the less combined and the more graphitic carbon the softer the castings, and it is not at all sure that such castings will not also be the stronger.

Practically the silicon should be varied until the quality suits, irrespective of the ratio between the carbons.

Again the size of the casting changes the percentage of silicon necessary, as slow cooling of large castings allow a smaller percentage of silicon to produce like results.

Mixture for Automobile Cylinders:—Silicon about 2.25 per cent P. about 1 per cent S. .075 Mn .5. The silicon should be as low as possible and machine easily. Purchase the irons that your market offers, which will produce such a mixture. You will find that some irons will give you cleaner castings than others and will in time find the most desirable mixture.

Mixture for Corliss Engine Cylinders of 1,800 to 3,500 lbs. weight.—Metal about 1¼ to 1½ in. thick? Silicon 1.20 to 1.60 per cent, sulphur less than .095, phosphorus below 0.70, Mn below .70 percent. See remarks on automobile cylinders.

Blow Holes or Drawing.—Where arms join the rim in heavy blank castings for machine cut gears? The ordinary way to prevent such shrunk spots is to reduce silicon as low as possible and allow of machining. The use of scrap with low sulphur will help. Low phosphorus allows the iron to set quick, but the best way is to use cast iron borings, 100 lbs. to the ton of iron melted. Pack clean borings in pine boxes holding 100 lbs. and nail the cover on tight. Charge the box on the coke before charging the pig iron.

Spongy Spots on Cylinders.—See remarks on Blowholes or drawing. The trouble in that and in your case comes from shrinkage after the surfaces of the casting has become set.

The reason that such spongy spots are located near the gate is that they are at the place that cools last. Have all parts of a casting of as even a thickness as possible. Founders are using chill pieces more and more each year, and will in the end place a chill on any surface when they are troubled with an open grain. This sets the iron quickly and so deep that the tooling will not cut into a soft spot. You should not use irons that will chill hard.

Molding in a Stove Foundry.

Question.—Is it good foundry practice in a stove foundry to mold up work and let it freeze up over a shut-down of a couple of weeks.

Would it affect the castings in any way?

Answer.—Very few castings can be saved if a mold is allowed to stand over until next day, even if it does not freeze. Freezing would dry the molds so that when thawed they would not be fit to pour. To pour iron into a frozen mold would chill the iron.

At a meeting of the stockholders of the Chas. Creighton Foundry Co., of New York City, the following officers were elected: John H. Allen, president and treasurer; Jas. H. Norris, vice-president and secretary; Chas. H. Thomas, manager.

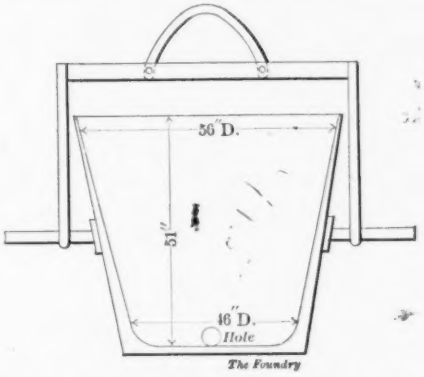
MALLEABLE CAST IRON NOTES.

BY DR. RICHARD MOLDENKE.

Time For Heat.

J. P. L. asks what time a fire should be started for a 20-ton heat in the air furnace, so that it can be tapped at 4:00 P. M. This naturally depends upon a number of things. First, whether the furnace is an up-to-date one which will turn out a properly mixed charge of this size in four and one-half to five hours. Some furnaces would not do this in six hours, and others might, with heavy fuel expense, cut the time down a little from the first mentioned figure. The second consideration is whether you charge on a cold bottom or not. If so, you can charge early enough in the morning, so that you can light up at 11:00 A. M. Should you notice that the heat will be ready before you really want it, you can throw in some extra pig iron to retard the heat, and then tap. Next day you can start up the fire a little later.

The second consideration is the mixture. The modern tendency is to get away from the



refining of the metal as much as possible. The additional strength gained from the burning out of the silicon and lowering of the total carbon is better attained by the direct addition of steel scrap to the mixture. Hence it is only necessary to melt the charge, and then heat it up to the proper pouring temperature, before tapping. The first test plug taken should show proper casting metal, though it may be necessary to hold the heat for ten of fifteen minutes to get it hotter. Adding steel for strength and quality means that about 30 points in silicon should be added to the composition of the castings wanted, for the silicon of the charge. This should prevent holding the heat in the furnace to refine it down to the proper point as in the old way of melting.

Tapping Hole for Reservoir.

J. P. L. further wants to know how large to make a tapping hole in a reservoir ladle as per sketch, and how long it would take to empty the ladle. The idea being to tap as in the cupola. We confess that once upon a time, during our university days, we were familiar enough with the calculus to work out this problem, granted that we could get the proper coefficients for melted iron, in place of water, in the calculation of the flow of water from given orifices, or to get the size of the orifice itself, when the quantity of water is given. Life is too short to go all over this mathematical matter long since on the shelves of our memory, and very dusty. We fear that the only way to get this information is to try it, and by repeated trials with small tapping holes at first, and enlarging them until the desired time of full discharge is found, the problem will be solved at least as fast as by calculation.

Incidentally, if the reservoir ladle is to be used for "malleable" for transportation, care should be taken to have the metal extra hot, as it loses fluidity every time it is repoured. In our own interests, we take away metal five tons at a time, but pour from the lip, and get excellent results, so that it is possible to carry hot metal for malleable casting purposes, if proper care is taken. This statement is liable to be doubted by several large works where carrying of the metal had to be abandoned because it got too cold to pour; but it is so just the same.

BRASS FOUNDRY NOTES.

BY C. VICKERS.

Manganese Bronze.

Inquiry.—Will you please give me a recipe for making manganese bronze, also state just how it should be compounded or mixed.

Answer.—"Manganese bronze" is made by simply adding manganese to any bronze or brass alloy, and the best manner of adding it is in the form of manganese copper.

An alloy for manganese with bronze is known as red manganese bronze and is used for bearings and other bronze parts of machinery. It may be either hard or soft according to the amount of tin. A soft alloy is:

Copper	64 pounds.
Tin	4 pounds.
Zinc	5 pounds.
Manganese Copper	5 pounds.

For a hard alloy use:

Copper	64 pounds.
Tin	8 pounds.
Manganese Copper	10 pounds.
Zinc	4 pounds.

When manganese is added to yellow brass it is called yellow manganese bronze, properly speaking it is a brass, not a bronze.

Such alloys are noted for their tensile strength. Any yellow brass can be converted into manganese bronze by the addition of from 5 to 10 per cent of manganese copper. From ½ to 1 per cent of aluminum should also be added. A good example of this class of alloys is:

1.

Copper	64 pounds.
Zinc	42 pounds.
Manganese Copper	8 pounds.
Aluminum	1 pound.

2.

Copper	64 pounds.
Zinc	30 pounds.
Manganese Copper	6 pounds.
Aluminum	4 ounces.

In melting manganese bronze keep the surface covered with charcoal, and do not "hold" the metal in the fire after it has become sufficiently hot, pour the yellow variety with the same precautions as with yellow brass. Manganese bronze shrinks almost twice as much as ordinary brass, such shrinkage must be overcome by the use of large risers, on the heavy portions of large castings, and the use of shrinkage balls on lighter castings.

Car Wheel Casting Difficulties.

Your subscriber's troubles are caused as he surmises both in the mixture and method of treatment. I see nothing particularly wrong in the designs of wheels, although curved spokes in mine car wheels and curved plates and ribs in ordinary car wheels are preferable to straight ones.

The ordinary method for making mine car wheels in Pennsylvania is to use a strong enough mixture to slightly chill the wheel and stand the shrinkage strains without annealing. Such as your subscriber was doing with No. 3 Southern iron.

To chill the rims of mine car wheels to obtain ⅛-in. or more depth of chill is a difficult thing for an ordinary jobbing shop to do successfully without the necessary annealing pit to counteract shrinkage strains.

Re-solid plate car wheels, nothing short of an ordinary good car wheel mix with annealing will make these wheels successfully as a mixture hard enough to give depth of chill will surely crack without the annealing process.

The fact of the wheels breaking under moderate pressure in mounting on axles or after mounting, indicates a poor mixture of iron as I have proved repeatedly by experience. Only a short time ago I replaced twenty pairs of 24-in. wheels having cracked hubs which had been in service but a short time under lumber cars. These wheels were made in an ordinary foundry.

To illustrate the strain there is on car wheels made of good mixture by the regular car wheel makers if the wheels are left to cool the same as an ordinary casting they always crack across the plate.

It may be possible to obtain a mixture of iron to give sufficient depth of chill and not crack without annealing but I have never come across it yet.

Chills should not be made less than 2½ in. to 3 in. thick and thicker as the wheels increase in diameter.

Standard 33-in. car wheel chills are seldom made less than 3½ in. thick.

Half silica sand and half loam sand will make a clean core.

J. C. WARNE.

REVIEWS.

Centrifugal Castings.

Eisenzeitung, Jan. 26. The Huth method of centrifugal casting seems to be meeting with much success in Germany. In this process the molds are given a centrifugal motion, while the metal is being poured in. Several kinds of steel or gray iron can thus be cast into the same mold, and give the desired results. Thus for a wheel, a hard steel is poured into the mold, immediately flying outward into the rim, then the soft steel is poured in, filling the mold. The result is a wheel with a hard rim and soft centre. Other castings can be made similarly. The advantages claimed are greater density, no shrinkage spots, which is saying much for steel castings; slag is kept from the outer surfaces, and the strains are not as prominent as would be the case with the ordinary molding methods.

The centrifugal method of casting is especially recommended for bulky castings whether

of one class of metal or more, on account of the greater freedom from openness and shrinkage.

Modes of Testing Cast Iron.

The Mechanical World. Feb. 10. Mr. W. T. MacCall, in a paper read before the British Foundrymen's Association, describes the various methods of testing cast iron. The ordinary cross-breaking test is the most common. One test piece is the one inch square and over three feet long, (broken on supports 36" apart). The other bar is as long and 2" vertical by 1" horizontal in cross section. The former should stand 2,000 lbs. before breaking, and the latter has a load of 3,000 lb. specified.

In the tensile test, the bar is turned down to 0.798" in diameter, and the heads are shouldered off to fit the machine. A breaking strain of 26,750 lbs. per sq. in. is specified, while the highest recorded strength in England is 40,320 lbs.

For the crushing test the sample should be about two to three times as long as the diameter, in order to get a fair test. In England bars for tensile or compressive tests are usually cast on and cut off the casting for subsequent turning up, while for transverse tests the bars are always cast separately. In America we are taking up standards a little nearer the ideal conditions under which cast iron should be tested, and the bars are shorter and heavier than the above sizes.

Economic Value of Cast Iron.

A paper was recently read before the Manchester Association of Engineers, by Mr. W. H. Pretty, in which he discusses the production of machine castings of maximum strength, uniformity and satisfactory machining qualities A very interesting editorial in the *Engineering Magazine* comments freely on the points raised. While everything points to the steel casting for machinery purposes, yet it must not be forgotten that cast iron offers advantages still better in given places, and therefore its study should be encouraged in order to locate these places and provide the best grade of material for them.

In the engineering field cast iron is especially useful for some parts of structural work, for bridges, tunnel linings, and water pipe. Then for castings in engine and machine construction, and finally for the malleable casting. In England the recently introduced segment castings for tunnel linings are going to the blast furnaces. Here the large foundries get them. The steel casting is bound to crowd the gray iron one, but the malleable casting will probably hold its own for a long while to come, if not for always.

Today we consider cast iron a compound of iron and carbon, manganese, silicon, sulphur, and phosphorus. Later on, Mr. Pretty predicts, such elements as chromium, arsenic, titanium, etc., will be looked after carefully in the pig irons we use. The melting methods will then be so improved that great strength should result, and the comparatively rarer ingredients thus become more important.

The study of cast iron from the chemical as well as physical standpoint has disclosed the reasons why certain results are obtained in the way of strength and other characteristics. We can now manipulate our material so that required standards can be met, and thus the value of the foundry product is greatly enhanced in the arts. The introduction of high speed steels has rather emphasized the necessity for soft castings, yet there is also a tendency not to sacrifice other good qualities simply for ease in machining. Mr. Pretty would like to see a shop test for the machining qualities of a cast iron adopted.

Quite a number of items which it will pay to follow out in the foundry laboratory and on the molding floor are enumerated. Among these are, for the cupola: The behavior of the blast under bad working conditions, and its effect on the quality of the iron. The formation of a cupola slag of standard composition, similar to other metallurgical slags for copper, silver, etc. The addition of proper reducing agents to take away oxidation, such as the alloys of iron with aluminum, magnesium, and silicon. The study of gases in cast iron, and the strains they may leave in the metal.

In the foundry proper, we have the effect of dampness in the molding sand. The characteristics of distribution of impurities, and the effect of frequent remelting. The decay of iron in service. The effect of temperature conditions on the metal and the heat treatment of cast iron. The microscopical study of cast iron. Finally the various classes of melting apparatus which can be used.

Our American Foundrymen's Association is highly commended for what it has done along the above lines, and it is predicted that the newly formed British Foundrymen's Association will also take its place in the front, a sentiment with which we Americans heartily agree.

ASSOCIATIONS AND SOCIETIES.

Philadelphia Foundrymen's Association.

Howard Evans, Secretary, care J. W. Paxson Co.

The 145th meeting of the Philadelphia Foundrymen's Association was held at the Manufacturers' Club, 1409 Walnut street, on Wednesday evening, March 1, with Vice President Alex. E. Outerbridge Jr. in the chair. There were about forty members and visitors in attendance. The treasurer's report showed a balance of $2,197.74 in the treasury, all bills to date being paid.

The secretary read a letter which had been received from the Associated Foundry Foremen of Philadelphia and vicinity, extending an invitation to the members of the Foundrymen's Association to become associate members of their organization and attend their meetings. This association was formed recently, one of the principal objects being the improvement of the working department of the foundry. Mr. Evans also announced that the subject to be presented before the Foundrymen's Association at the meeting in April would be "Foundry Costs," and the probable subject for May would be "Cores and Core Making."

The paper of the evening was read by Thorsten Y. Olsen, of the firm of Tinius Olsen, of Philadelphia, Pa., the paper being entitled "The Fremond Method of Testing the Fragility of Iron and Steel." The paper was illustrated with stereopticon views and was very interesting indeed. It provoked considerable discussion and the author was tendered a vote of thanks.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, care of Barbour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, on March 8, at 4:30 P. M. Vice President W. B. Snow presided. The secretary reported the illness of President John Magee and stated that flowers had been sent him on behalf of the association.

Reports were received from the committees on securing new meeting quarters and on the pig iron storage warrant system. These were accepted and filed. The quiz questions arranged by the committee were then discussed as follows:

Ques. What is the best sand to use for making medium brass and bronze castings?

Ans. In the hardware business we find that No. 0 Albany sand for brass castings and No. 1 Albany sand for plain castings is the best that can be used in making up hardware. The Albany sand is strong sand to start with and it is also a stronger sand after being worked.

Ques. Do you use salt in tempering the sand?

Ans. Salt is just as necessary to sand as lime is to sand in order to make it strong. There is no molder that can produce a casting without any salt in the sand. We can produce just as good a casting in green sand in high brass, but we cannot do it without salt. Salt gives the sand strength and without it a molder would be helpless. He could not produce the fine work which we produce today.

Ques. How much salt do you use?

Ans. In proportion we use about ¼ lb. salt to a bucketful of water.

Ans. There seems to be a vast difference of opinion on that point. We use No. 1 Albany sand and we find we can get as good results with No. 1 Albany as with No. 0 sand. If you get in too much French sand, it gets too strong. In regard to French sand, we call it sand, but it is more of a clay than sand and the clay, by ramming up the mold, will make it quite air tight. The question of today is how will the foundryman go to work to make all his gas escape. If he can do that then he is sure of a good sound casting.

Ques. What has been your experience in the use of old or burnt core sand in mixture?

Ans. We use old core sand because it is absolutely necessary in making up good castings. The old core sand is more porous and allows the gas to escape more readily than new core sand.

Ans. We have started recently to use old core sand on certain mixtures. We are today using about 20 percent on medium sized cores and about 30 percent on larger cores. We use a dry compound and that is the only thing that will hold core and sand successfully. We can handle more old sand with the dry compound.

Ques. What success have you had with core compounds or core oils?

Ans. The smallest core we make is about ⅛ in. diameter and I find that the core compound is the best binder. It is far better for the cores than core oil.

Ans. Going back to the old methods of core making, you can make a core of glue, or a core of flour, or a core of core oil, or any other compound which is in the market to-

day, but the main point is this. Sometimes the foundryman condemns a good article, he never goes far enough to investigate what the reason is that his cores blow. In all probability he does not vent the core properly. If the core is 3½ in. long it should be vented 2½ in. and the coremaker has vented it only 1 in. When the molder puts that core in the casting there is a blow there. The main point in making a core is the venting of the same.

We have tried core oils and compounds but are now using burnt sand with glue. We found with core compounds and core oils it took us so long to get the core out of the top of a small hole that we had to go back to the old method of core making.

After a short intermission the meeting adjourned to dinner. At the evening session the president introduced as the speaker Mr. Geo. H. Hull, of New York, president of American Pig Iron Storage Warrant Co., whose remarks were on the use of the warrant and certificate system by foundrymen in supplying themselves with pig iron. He said that the warrants were simply a receipt for 100 tons of pig iron. They designate on the face the brand, grade and weight, and upon the return of the warrant the 100 tons as described on the face of the same would be put on the cars free of charge. Iron bought on these warrants are purchased on both analysis and fracture grading. At the conclusion of the speaker's remarks there was some discussion, after which a unanimous vote of thanks was extended to Mr. Hull. The meeting adjourned at 9:50.

Indianapolis Foundry Foremen.

W. H. Holmes, Dist. Vice Pres., care American Foundry Co.

At the March meeting of the Indianapolis Foundry Foremen, Mr. Keller read a paper on "Core Making." The Indianapolis Club has gotten out a postal card which they send out to each member previous to the meeting, stating the date on which the meeting will be held, the subject of the paper to be read, and requesting that the members come prepared to discuss the same.

Hamilton, Ont. Foundry Foremen's Association.

A. Chase, care Sawyer & Massey Co., Secretary and Treasurer.

During the winter the foundrymen about Hamilton have met a number of times to discuss the subject of forming a local branch of the Associated Foundry Foremen. On Saturday night, March 11, a meeting was held at which the final organization was perfected, the charter having been received from New York. The following officers were elected: David Reid, of the Canadian Westinghouse Co., Ltd., president; Frank Reid, of D. Moore & Co., vice president; A. Chase, of Sawyer & Massey Co., secretary and treasurer. The president appointed the following executive committee: Thos. Simpson, Canadian Iron Foundry Co., city; John Dale, Sawyer Massey Co., city; George Manning, with John Bertram & Co., Dundas; Jas. Dowling, city; Samuel Brown, Canadian Westinghouse Co., city.

The foundry foremen of Brantford, Dundas and St. Catherines were also invited to be present at the meeting. The principal paper of the evening was by Dr. Richard Moldenke, of Watchung, N. J., but as the doctor could not be present the paper was read by Mr. Reid, and provoked considerable discussion.

On account of the fact that the election of officers and other routine business had taken up a great deal of time, it was impossible to discuss the paper as extensively as it was desired, and hence it was voted to continue the discussion at the next meeting. Before adjournment the members passed to an adjoining room, where an elaborate luncheon had been prepared. A hearty vote of thanks was extended to Dr. Moldenke for the paper presented.

PITTSBURG FOUNDRYMEN'S ASSOCIATION.
F. H. Zimmers, Secretary, care Union Foundry and Machine Co.

THE ASSOCIATED FOUNDRY FOREMEN.
Frank C. Everitt, Secretary, 2413 Third Ave., New York, N. Y., care The J. L. Mott Iron Works.

CLEVELAND FOUNDRY FOREMEN.
W. H. Nicholls, 608 Gordon Avenue, District Vice President.

PHILADELPHIA FOUNDRY FOREMEN.
W. P. Cunningham, Secretary, Pencoyd, Pa.

ERIE FOUNDRY FOREMEN.
W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.
S. M. Williams, Dist. Vice Pres., 221 Third Street, Elizabeth, N. J.

CHICAGO FOUNDRY FOREMEN.
David Spence, Dist. Vice Pres. 142 Bunker St.

MILWAUKEE FOUNDRY FOREMEN.
Thomas Glasscock, Dist. Vice Pres., care Pawling & Harnischfeger Co., Milwaukee, Wis.

CONTINUOUS PROCESS FOR CAR WHEEL MANUFACTURE.

No branch of the iron and steel industry offers wider possibilities for the production of duplicate parts than the foundry trade, and in the past few years many continuous processes have been tried with more or less success. No steel plant is considered modern today without a continuous mill and it can be safely predicted that in the very near future every specialty foundry will operate on some continuous semi-automatic system. Labor troubles in foundries have fostered the molding machine, and the further replacement of skilled labor by the unskilled and cheapening of labor costs will bring about continuous processes. At Pittsburg a continuous steel belt was tried in one of the largest malleable shops for conveying molds to the casting floor, and practically all continuous processes tried have been designed to prevent the shaking down of molds when taken from one floor to another. The steel belt was discarded as it was impossible to prevent the vibration which resulted in the destruction of an unduly large percentage of molds. At another specialty shop the molds were placed on floats in a large water tank, but the tipping of floats with the consequent destruction of the molds soon resulted in the system being discarded. Outside of the car wheel line, no attempt has been made at operating continuously with a process that combines molding, casting and stripping.

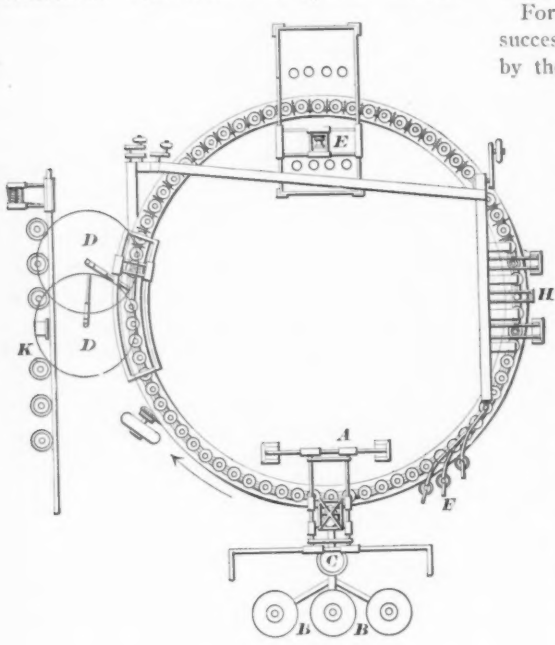


Fig. 1

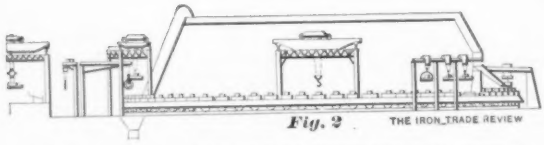
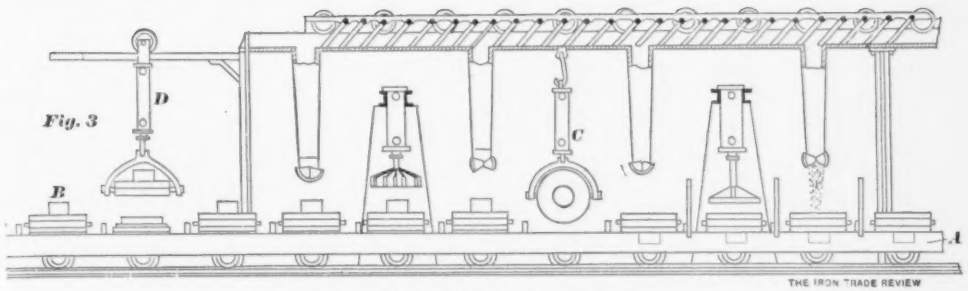


Fig. 2 THE IRON TRADE REVIEW

PLAN AND ELEVATION OF CONTINUOUS CAR WHEEL MOLDING AND CASTING PLANT.

For nearly two years car wheels have been successfully made at a plant near Pittsburg by the Sherman process, the invention of C. W. Sherman, of Bellevue, Allegheny county, Pa. Mr. Sherman's wide experience as a car wheel manufacturer led him to the conclusion that by the installation of a continuous process and a division of the work on each wheel would facilitate the manufacture, better the product, and effect a saving in the labor.

As shown in Fig. 1, the plant consists of an endless track and mold conveyor 100 ft. in diameter with space for 72 car wheel flasks. Each flask is allowed approximately 52 in. of space on the ring. The movement of the conveyor is intermittent and the distance moved is equal to the space occupied by one flask. The molding is accomplished by the use of ten patterns and each pattern is placed in a flask at A shown in Fig. 3, which is an enlarged elevation of the molding section. As the flask moves from point to point sand is fed from overhead spouts at point H in Fig. 1, and each man does that portion of the work assigned to him and this labor is the same on every wheel. When the flask leaves point B, Fig. 3, with the pattern withdrawn the mold is ready to be poured. The coping device is shown at F, Fig. 1. The sand ramming devices shown in Fig. 3 have not yet been used, this work now being done by hand. The pouring is accomplished by the use of a bottom pouring ladle as the mold passes the pouring crane A, Fig. 1, the iron being supplied in the usual manner from cupolas B and ladles C in Fig. 1. The stripping of the wheels is done at a cherry red temperature near the annealing pits, the pits being indicated by K, Fig. 1, the scope of the pouring and stripping

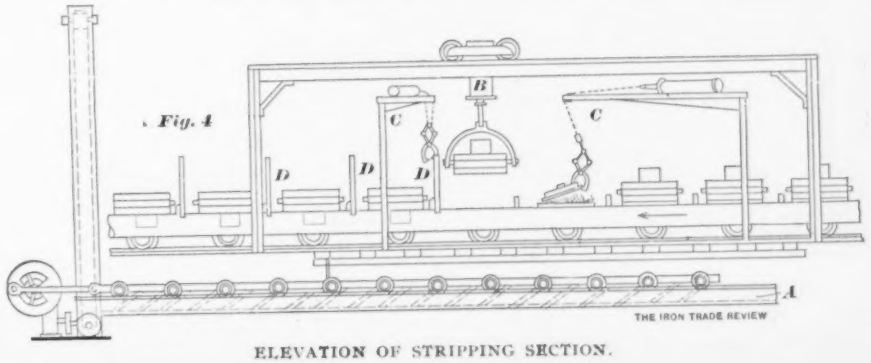


ELEVATION OF MOLDING SECTION.

cranes being such as to allow the proper time between pouring and stripping each wheel regardless of the speed of molding and melting. The wheel casting is removed with crane D, Fig. 1, from the conveyor car and placed in position for the pit, in one operation. The pitting crane is at G. Fig. 1. As the sand is removed from the wheel it drops into conveyor A, Fig. 4, and is automatically screened, mixed and tempered as shown in Figs. 8 and 9, while being conveyed to the molding section and the empty flask is replaced on the conveyor and passes under crane E, Fig. 1, where it is removed and a cold one placed in position ready for use. About one hour and 45 minutes is required for a flask to make a round of the entire operation and in operating 10 hours a day the same flask can be used twice, thus effecting a saving in a foundry's flask equipment of about one-half.

The track construction on which the conveyor moves consists of 70-lb. T rails curved to the proper radius and resting on ordinary cross ties. Figs. 5 and 6 show an endless conveyor, but the present installation consists of a system of cars, each holding two flasks and made of upright plates A, Fig. 6, and aprons B, of bent plates, forming a protection for the wheels which operate loose on the axles and also the rails at the stripping and molding sections to prevent any loose sand from blocking the track.

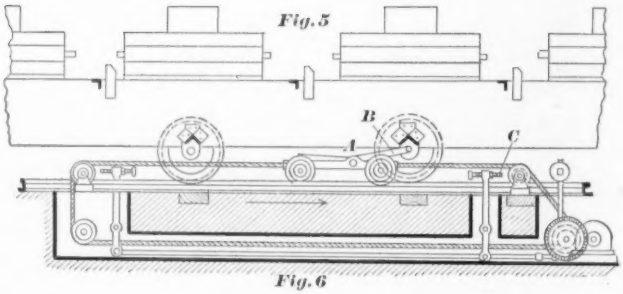
The radial axles have the distance from the axle of one car to the axle of the next, the same as between the axles on the same car, and the cars are coupled by a universal device, which will be simplified by the use of a continuous conveyor. Figs. 5 and 6 show a side view and cross section of the conveyor at the operating point. Trolley A, Fig. 5, is so applied to the conveyor as to allow the return movement without engaging the axles. Dog B works against the axle on its forward movement only, and the trippers CC act on the clutch A, Fig. 7, and reverse the movement of the trolley from either direction while the motor runs steadily forward making the movement automatic. The trolley track inside the conveyor track in Fig. 6, extends only the distance of the operating mechanism. The propeller is connected to drums B and C, Fig. 7, by a wire cable shown in Fig. 5, and by referring to Fig. 7 it will be seen that one drum is loose on the shaft while the other is in operation and vice versa. The drums shown are of different sizes to proportion the periods of travel and rest for the main conveyor and allow the proper time between movements for doing the work at various points on the circle. It has been found that a 15-h. p. motor is sufficiently large to move the whole train.

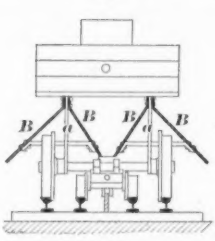


ELEVATION OF STRIPPING SECTION.

Fig. 3 shows the reciprocating sand conveyor and down spouts for feeding the sand to cope and drag sections of the molds. The gates on the sand spouts operate by a lever. The roll-over hoist C in Fig. 3 is at a convenient point to roll the flask over immediately after the bottom board has been fastened and the coping device D travels in line with the center of the conveyor and leads off the center line in Fig. 1 at F. Fig. 4 shows a pneumatic crane B, which travels in line of the conveyor and the wheel removing cranes C and C. The stripping operation is carried out as follows: Crane B removes the cope, chill and drag from the casting and replaces the flasks on the conveyor in a vacant space ahead, and the wheel is taken from the conveyor by ordinary wheel tongs operated by pneumatic jib crane C and deposited in position for the pitting crane G, Fig 1. The bottom board is then placed in an upright position as at D, and all the remaining sand drops through the cars and open track into conveyor A. The car and grating construction around the stripping section prevents any chunks of iron or scrap from falling through which cannot be easily handled by the conveyor A and removed from the sand by screen A in Figs. 8 and 9. The sand passes along conveyor A, Fig. 4, into screens A, Figs. 8 and 9. This mixer has a system of paddles attached to a shaft for thoroughly mixing the sand while it is being cooled and tempered. The sand is discharged at the opposite end into elevators and conveyors for delivery to the molding section ready for use.

The advantages of the system are many, resulting in uniform molding with comparatively unskilled labor, each man confining himself to one molding operation and an intelligent laborer can be taught his portion of the work very quickly. It has been found by actual operation and in the production of 400 wheels daily the average molding loss is about 2½ percent. All the pouring is done at one point near the mixing ladle, which avoids variations in temperature of the iron poured owing to its conveyance to a distant portion of the shop or near the cupola in an old system shop. The time of stripping all wheels is under the control of the man in charge which insures the pitting being done at the proper temperature and the wheels follow each other uniformly, exactly the same time elapsing between the pouring and pitting of every wheel. This is impossible under the old floor system where the wheels are conveyed variable distances before pitting. By this continuous system the heat from the pouring and stripping is entirely removed from the molding section and all wheels are stripped and pitted in the shortest time possible, reduces the loss of heat by radiation, bottles it up in the pit for annealing and avoids roasting the men at the work. A trial of this system through two summers has proved the pouring





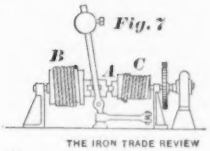
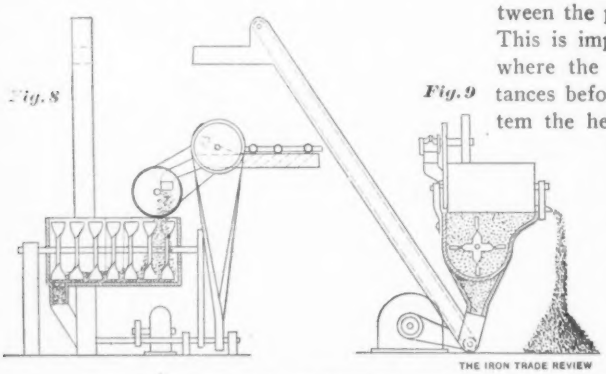


FIG. 5.—MOLD CONVEYOR SHOWING AUTOMATIC STARTING AND STRIPPING DEVICE. FIG. 6—CROSS SECTION OF MOLD CONVEYOR AND PROPELLING DEVICE FIG. 7.—DETAIL OF DRIVE AND CLUTCH.



CROSS SECTION OF SAND SCREEN AND MIXER.

and stripping to be much easier than under the old floor system and is due to the fact that only one ladle of iron and not more than two wheels are radiating heat in the shop at the same time. Under the old system each molder and helper handles 4½ tons of sand three or four times a day, which is done mechanically by this improved method, the whole operation of handling the sand, molten iron, hot wheels and flasks is reduced to a minimum and Mr. Sherman is now perfecting a molding device to complete the cycle of mechanical operations necessary to the manufacture of machine molded car wheels.

The number of men required to operate a plant equipped as shown in the drawings is as follows:

No. of Men.	Occupation.	Wage Per day.	Total.
1	Painting Chills	$1.25	$ 1.25
12	Sand Rammers	2.50	30.00
4	Finishers	4.50	18.00
1	Clamp Up	2.00	2.00
1	Pourer	3.00	3.00
1	Ladle Attendant	1.50	1.50
6	Shaking Out	1.75	10.50
2	Changing Flasks	1.50	3.00
1	Tempering Sand	2.50	2.50
2	Pitting	2.00	4.00
1	Cupola tender	3.25	3.25
1	Cupola tender helper.	2.00	2.00
2	Laborers	1.50	3.00
	Total		$84.00

The above number of men will produce 350 good wheels in 10 hours which makes a total cost of 24 cents per wheel from molding to pitting inclusive and is a saving of 21 cents per wheel from molding with 35 cents for molding and 10 cents additional for foundry labor under the old system. With the application of the molding device for which a patent has been asked, there will be a further saving making the total aggregate 25 cents a wheel.

MENDING A CASTING WITH THERMIT.

In the February number of *The Foundry* I notice you gave considerable space to Aluminothermics. Having had some experience with this metal I thought I would offer it to your valuable paper and if you deem it worth space it may be the means of assisting someone who may have occasion to use thermit for mending. The W. H. Mullins Sheet Metal & Structural Works, of Salem, O., had a large 8-ton anvil for a drop hammer break at the point where one of the guides bolted on, and as the anvil was worth about $600, they thought it would pay them to weld it with thermit.

Not caring to undertake making the molds they requested the Silver M. F. G. Co., of Salem, O., to do that part of the work. Mr. Homer Silver, the superintendent of the foundry department, assigned the writer to do the work. I will now describe as close as I can the way the work was done. Owing to large brace ribs on the anvil it was impossible to take the molds from the broken anvil and we requested them to take plaster casts from the broken anvil and make a duplicate of the broken end of the anvil out of plaster. We then made a box which we nailed loosely together, made a cast core arbor and made the cores from the plaster duplicate. After the cores were rammed up and taken away from the plaster duplicate we pulled the box apart and took it away from the cores, thus saving the trouble of making iron boxes as was recommended by the circulars sent us by the thermit company, and I believe that the cores will dry better and a better opportunity is given the vent to escape. Also a better opportunity to guard against leak or runout by dispensing with the iron box.

The mixture we used for the core where it came in contact with the thermit metal was 40 percent china clay and 60 percent sharp sand; this we used as a facing, filling the rest of the space with common core sand. After the cores were dry we mixed a clay wash with the china clay about as thick as milk, and into a quart of this clay wash we put one pound of a good quality of graphite facing and painted the parts of the core exposed to the metal with this wash.

The core stood the metal and showed no scabs or blows. The cores were too large to handle by hand which made our job fitting them to the anvil a little more difficult. The lower core we left remain on the core plate placing it beneath the anvil,, we raised it into position and secured it there. We then fitted the top core in place temporarily, then taking it away we cleaned out the molds and heated the anvil to about a red heat. The top core was then put in place permanently and clamped from the plate beneath the bottom core to the cast iron arbor in the top half of core. We then rammed sand above the joint to prevent a runout. The basin for the surplus metal was in the top half of core, the

slag basin we made by taking an old drag and lining it with common molding sand as one would do in makng a runner.

The crucible was put in place and 350 lb. of thermit metal and 50 lb. of steel punchings placed in it as directed by the Thermit Co. The igniting fuse was lighted and the metal let stand one minute before tapping. Notwithstanding the short time it required the metal to run out of the crucible the heavy walls and metal jacket of the crucible were white hot on the outside by the time the metal was all out. To the naked eye it looked much brighter than an arc light. As for the violence of the reaction any one who has ever seen a mold blow up, and I think we all have, has seen more violence than the writer saw from the thermit reaction.

The weld was successful but I would advise anyone contemplating using thermit to weld cast iron to multiply by three instead of two as directed by the Thermit Co. That is, find how many pounds of metal it will take to fill the fracture thermit collar gates and multiply this by three and that will give the amount of thermit required if you wish to be sure of success.

The Thermit Co. says to run as much metal through as is required to fill the fracture and thermit collar, but from what I saw of Thermit I don't believe that in welding cast iron that amount is enough.

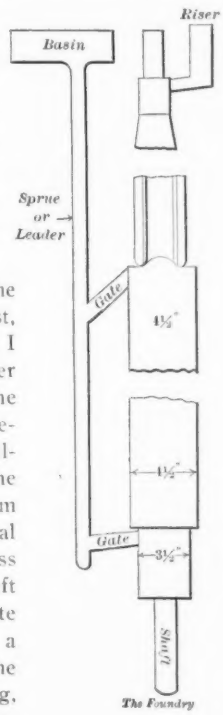
When I was making these cores I bared one of the spurs of the cast iron arbor and placed a wrought iron rod in the core beside the cast spur with the end exposed in a like manner to see which metal it would adhere to the best. When we stripped the molds off the wrought iron rod was welded to the thermit steel and in trying to get it away it broke off above the weld, but the cast iron spur did not even take hold which led me to believe that more thermit is required to weld cast iron than it would require to weld wrought iron or steel.

As far as the foundry is concerned I do not believe that that thermit at its present price will be of much value. Unless the casting was a very valuable one it would not pay to attempt to mend it, and if a customer was paying a large sum for a casting he would hardly take one that was patched. Owing to the enormous shrinkage of thermit it is useless for filling holes in castings, and if a light or delicate casting were operated on with thermit it would surely weaken or break it. The only way in which I can see that thermit might be of use to the foundry would be in the blending of iron and steel. The iron could be drawn from the cupola and thermit melted in the crucible and mixed without the steel coming in contact with the impurities of the cupola which are so injurious to steel. But to the machine shop where the breaking of some part might cause the shutting down of the shop or a machine the value of thermit as a mending agent can be estimated only by value of the time which it would require to get a new part, which in some cases would be very great. The little experience I had with thermit was very interesting to me and I think there are many uses to which this metal will be put and by the exchange of our experience with thermit we will all learn its real merit.

PATRICK REDINGTON.

CASTING IRON ON STEEL.

In answer to G. L. B.'s casting difficulty, I would suggest to him that on this particular job he ram the mold in the vertical position, taking the precaution to gate the mold where the drawing shows diameter of casting to be 3½ in. This, in my opinion, should be the bottom end, as the shaft protrudes more and has a better hold where the strain would be greatest, in addition to this gate I would still cut another slightly smaller at the top of the 4½ in. diameter with the idea of filling the mold up to the height from the bottom gate, then as the metal rises to a more or less dull degree than it left the ladle the upper gate will help to enthuse a new life to it with the result of a better casting, an extra inch of pattern to be turned off the upper end of casting would also be of benefit, but if this is not practicable place a riser thereon. After securing by clamping, cast on end, as I do not know what kind of a flask you are using, great care will be necessary to overcome extra strain if tackle is weak.



WM. LEARY.

TRADE PUBLICATIONS.

The Ingersoll Sergeant Co. have issued another small catalogue 4½ x 3¼ in., entitled "Air Compressors." In this, one machine of each type which they build is illustrated, and a short statement given as to its distinctive features and the work for which it is adapted.

Warren-Webster & Co., of Camden, N. J., are sending out a reprint of a paper entitled "Circulation of Steam for Heating Purposes, at or below the Pressure of the Atmosphere." This paper was read by request before the American Society of Heating and Ventilating Engineers, by Reginald Pelham Bolton. In this paper the author treats very interestingly the subject of low pressure circulation for heating purposes.

The Rockwell Engineering Co., of New York City, have issued a new catalogue describing the Rockwell double chamber melting furnace. The catalogue is gotten up in very neat style and fully illustrates the use of this furnace, showing the method of operation in detail, also the method of lining. In addition to this, a comparative statement is given, showing the cost of operating this furnace and the ordinary style of crucible furnace.

The Ingersoll-Sergeant Co. have started a set of bulletins which are being sent out from their pneumatic department. The first one is entitled Bulletin No. 2,000, and deals with the McDonald rivet forge. This forge would be a very handy device for use in a foundry where a limited amount of smith work was required.

PERSONALS.

James S. Stirling, who was recently elected president of the Crescent Shipyard Corporation and of the S. L. Moore & Sons Corporation, subsidiary companies of the Bethlehem Steel Corporation, has risen rapidly during his business career. Mr. Stirling, who is not yet 34 years old, entered the cost department of Harlan & Hollingsworth Co. in 1891, and in 1892 was made superintendent of the foundry department. In January, 1903, he became vice-commissioner of the National Founders' Association. He continued in that position until he resigned to become associated with the S. L. Moore & Sons Corporation. Mr. Stirling was vice-president for three years of the Philadelphia Foundrymen's Association and was a member of the third district committee of the National Founder's Association during 1901 and 1902.

Mr. Benj. J. Downs has bought an interest in and taken charge of the Harry A. Spears brass foundry, 130 Oliver street, Boston, Mass. Mr. Downs has had years of experience as foreman and is a progressive foundryman.

Mr. Hugh McPhee, foreman of Eaton, Cole & Burnham Co.'s brass foundry at Bridgeport, Conn., gave a very interesting talk on molding before the Mechanical Club of the Y. M. C. A. of that city. He illustrated the talk by making a mold and pouring it with white metal.

On March 2nd, Mr. E. H. Mumford, of the Tabor Mfg. Co., Philadelphia, Pa., read a paper on foundry molding machines before the Franklin Institute.

Wesley R. Mason has been promoted to the position of district manager at the Detroit shops of the American Car & Foundry Co., as successor to George Hargreaves, resigned. Mr. Mason, although a young man, has been connected with the company 17 years. D. W. Hawksworth, who has been mechanical engineer for the company at Detroit, will be assistant to Manager Mason.

Mr. C. B. Murray, for may years chief chemist of the Carnegie Steel Co., at its Edgar Thomson Works, has associated himself with Mr. G. P. Maury in the active management of the Metallurgical Laboratory, 611 Bailey-Farrell Building, Pittsburg, Pa.

FIRES.

The foundry plant of the Rogers Machine Foundry Co., of Riverside, Cal., was damaged by fire to the extent of $3,000 on March 6th, with $2,000 insurance.

The foundry plant of the Hardie-Tynes Foundry & Machine Co., of Birmingham, Ala., was damaged by fire on March 12th to the extent of $20,000, which is covered by insurance. The fire evidently originated in the core ovens.

The foundry of I. Droege & Sons, of Covington, Ky., was visited by a serious fire on March 6th. The molding department was entirely destroyed, together with some new tools and a large amount of stock. The loss is estimated at $35,000, which is fully covered by insurance. The engine room, pattern and pattern storage departments and some other departments were saved.

A fire which started in the molding shop of J. Fleury's Sons, Aurora, Ontario, Feb. 28, destroyed core boxes in use and did considerable damage to the roof. Loss $2,000.

The Crawford-Speer Foundry & Machine Co.'s plant at Bridgewater, Pa., was destroyed

by fire on Feb. 15, entailing a loss of about $9,000, which is offset by $4,000 insurance.

The foundry of Engelman & Sons, of Benton Harbor, Mich., was slightly damaged by fire on Feb. 16th.

The foundry plant of the Bovee Furnace and Grinder Works, of Waterloo, Ia., was destroyed by fire on March 3rd, with a loss amounting to $15,000, which was partially covered by insurance. The work of the foundry will be done in other foundries in the city until the company can rebuild the burned structure.

The plant of the Davis Foundry and Machine Works, in West Rome, Ga., was destroyed by fire on March 3rd. The loss was about $9,000, partially covered by insurance.

The foundry of the Flint-Lomax plant at Denver, Colo., was damaged by fire to the extent of $2,500 on Feb. 23. The loss was fully covered by insurance.

A fire in the plant of the Jones & Bruce Foundry, Cincinnati, Feb. 25, partially destroyed the plant, causing a damage of $2,500.

The Lakeside Malleable Iron Works, Lakeside, Wis., three miles south of Milwaukee, was burned March 1. The plant was valued at $125,000, and is a total loss. The Bruce Engine Co.'s plant and the Racine Iron & Steel Works were damaged.

The Fort Payne Stove Foundry, of Fort Payne, Ala., was visited by fire on Feb. 23rd, and a large portion of the plant destroyed. The office, stables and pattern department were about all that were saved.

McCormick & Co.'s foundry at Pittsburg, Pa., was slightly damaged by fire on Feb. 21.

The plant of the Missouri Malleable Iron Co., of East St. Louis, Ill., was visited by a fire on March 7th, with a loss of $100,000. A considerable portion of the plant, however, was saved.

The foundry of the Cedar Falls Iron and Brass Works, of Cedar Falls, Ia., was destroyed by fire on Feb. 15th. The loss was $20,000, against which there is only a small amount of insurance.

A portion of the foundry and the pattern department of Pascal Amesse, Montreal, Canada, was damaged by fire on Feb. 24th. The damage is estimated at 1,500, being largely due to the destruction of valuable patterns.

The foundry connected with the plants of the Barcus Horse Stock Co. and the Wabash Stove Co., of Wabash, Ind., was burned on March 5th, with a loss of several thousand dollars, upon which there was a small amount of insurance. The most important loss was the patterns, among which there was a full set for automobile engines.

NEW CONSTRUCTION.

Abendroth Bros., New York, will build a new molding shop 90 x 175 ft. at the plant in Newburgh, N. Y. They will also erect a machine shop 50 x 140 ft., six stories high.

Plans are being perfected by Stanley G. Flagg & Co., Pottstown, Pa., for the erection of a building on the site of the foundry recently destroyed by fire. The new building will probably be larger than the old structure.

The Central Foundry Co., of Vincennes, Ind., are planning to build an addition to their plant which will give them from 15 to 20 more molding floors.

The Butler Foundry & Iron Co., of Chicago, Ill., has taken out a building permit for a one-story addition to its plant, to cost $8,000.

The Missouri Malleable Iron Works, East St. Louis, Ill., will rebuild the annealing building which was destroyed by fire March 7. The new structure will be 110 ft. wide by 150 ft. long, and will cost about $45,000.

The Joy Stove Works, of Chicago, Ill., are to construct a new plant at a cost of about $25,000.

M. A. A. Guilbert is making plans for a new foundry for the Lakeside Malleable Casting Co., of Racine, Wis., to take the place of the buildings recently destroyed by fire. The buildings are to be constructed of steel and concrete.

Plans have been completed for a new factory, including a foundry, for the Aldine Grate & Mantel Co., at Grand Rapids, Mich. They expect to build their plant in the near future and to have it in operation by August.

The I. Droege Foundry Co., of Covington, Ky., expect to replace their plant, which was recently destroyed by fire, with a steel structure. Temporary quarters for carrying on the work will be erected in the meantime.

J. H. Newbury, of Middletown, N. Y., is planning to erect an addition to his foundry at Goshen, N. Y. The addition will be 40 x 100 ft. and will be occupied for offices, while present offices will be fitted up for a machine shop.

A building permit has been granted to the Central Iron Works, of Syracuse, N. Y., for the construction of several buildings including a foundry.

Work at the Kerbaugh plant, near Bellwood, Pa., is progressing rapidly. Several of the buildings are practically completed and it is expected that the plant will be in operation

May 1st. The machine shop will be 120 x 230 ft. and the foundry 50 x 50 ft.

The work of rebuilding the foundry of Theodore F. Conner, of Bloomsburg, Pa., has been begun and will be pushed as rapidly as possible.

The J. B. Morris Foundry Co. will erect a large concrete addition to their foundry at Cincinnati, O.

The Carroll Foundry & Machine Co., of Bucyrus, O., will erect a new steel foundry building 130 x 300 ft. during the coming summer.

Work on the new Day-Ward foundry at Warren, O., is progressing rapidly.

Jas. H. Rhodes, architect, 429 Broadway, Logansport, Ind., has plans for a four-story machine shop, 50 x 150 ft., and a one-story foundry building 60 x 100 ft.

McCarthy & Malinski, of Cairo, Ill., have commenced the erection of their new foundry and machine shops at Cairo, Ill.

The Prescott Co., at Menominee, Mich., contemplates erecting a foundry for the manufacture of steel castings.

The Kalamazoo Stove Co., Kalamazoo, Mich., which recently increased its capital stock from $200,000 to $315,000, will erect a large warehouse 300 x 215 ft., and a power building to enclose a 350 H. P. Buckeye tandem compound engine, Union Steam Pump Co.'s pumps. condenser, Cahall boilers and a Crocker-Wheeler generator direct connected.

The Detroit Steel Casting Co., Detroit, whose plant was recently destroyed by fire, will build on a much larger scale than at first contemplated. There will be a large additional equipment.

The Harlan & Hollingsworth Co., of Wilmington, Del., are making quite extensive changes in their plant, and are preparing for the erection of a new foundry.

The Standard Sanitary Mfg. Co. have awarded a contract for the construction of the additions to their plant at Louisville, Ky., including a foundry and warehouse. The additions will cost about $50,000. The foundry will be 150 x 280 ft., and there will be several other large buildings.

Work has been progressing as rapidly as possible on the plant of the Bacon-Collins Co., of Albany, Ga., but it is probable that their machine shop and foundry will not be completed before May 1st.

Mr. Maddox, of Jacksonville, Fla., is planning to erect a foundry and machine shop, which he expects to have in operation in the near future.

A foundry is being added to the Burns Boiler & Machine Co.'s plant at Jonesboro, Ark. This will enable them to do work which they have formerly had to get from Memphis, Tenn.

The Davenport Locomotive Co., Davenport, Ia., will erect a large addition to its plant, a tract of 12 acres having been purchased recently for that purpose.

The Olbrich & Clay Foundry at Cedar Falls, Ia., which was recently destroyed by fire, will be rebuilt.

Geo. Clare, president of the Clare Mfg. Co., of Preston, Canada, recently visited Winnipeg, Manitoba, and made arrangements for the erection of a foundry plant by his company. They have purchased five acres of ground and will begin work in the near future.

GENERAL INDUSTRIAL NOTES.

We are informed that the new works of Geo. G. Blackwell, Sons & Co., Ltd., Liverpool, England, for the manufacture of ferro-silicon are completed, and will be in operation early in April. They will have the largest output of ferro-silicon of any works in the world and will produce grades as follows: 25 per cent, 50 per cent and a third grade varying between 70 and 75 per cent. They will take great pains to have their alloys low in phosphorus, and also state that their grades containing a high percentage of silicon are made in such a way that they will not crumble into a powder but will remain solid.

Keith Furnace Co., Des Moines, Ia., has just completed the erection of a new building to be used for offices and a pattern room. The space in the main buildings formerly used for this purpose will be given over to the foundry and assembling departments.

The new plant of the Leyner Engineering Co., at Littleton, Col., erected on state land, has been completed. The machine building is 280 ft. long and is planned for lengthwise extension to 400 ft. The forging building is 61 x 161 ft., and the pattern building 41 x 141 ft.

At the recent annual meeting of the American Hardware Corporation, New Britain, Conn., it was decided to increase the capital stock from $5,000,000 to $7,500,000, a part of the new capital to be used in purchasing the Corbin Cabinet Lock Co., which has a capital stock of $200,000. The stockholders chose the following directors: Philip Corbin, Andrew

Corbin, Charles M. Jarvis, A. J. Sloper, Charles H. Parsons, Charles Glover, Howard S. Hart, S. C. Dunham, of Hartford; Frederick P. Wilcox, John H. Whittemore, of Naugatuck; Charles Miller, of Waterbury, and George W. Corbin. The last two named directors were added to the board to represent the Corbin Cabinet Lock interests, and the board otherwise remains the same as last year. The corporation has recently increased its dividend from 2½ per cent yearly to 1 percent. The directors' annual report of the American Hardware Corporation gave the total assets of the subsidiary companies as $7,992,201; the bills and accounts payable amounting to $868,532, leaving the net assets $7,123,668. The net earnings during the year were $548,240, about the same as in 1903.

The Niles-Bement-Pond Co., of New York, have purchased the plant of the Cresswell & Waters Co., Philadelphia, Pa., which includes a machine shop and foundry and some other buildings.

The Johnstown Foundry & Machine Co., of Johnstown, Pa., has applied for a charter. The new plant is to manufacture iron and steel castings, mine cars and other machinery. This is a reorganization of the Cambria Foundry & Machine Co., and the incorporators are Geo. A. Hager, John W. Walters, N. Bruce Griffith, Harry M. Benshoff and John N. Horn. The company is to have a capital of $30,000.

The Globe Foundry Co., of Port Chester, N. Y., has been incorporated with a capital of $40,000. The incorporators ore C. H. Underwood, Henry D. Merchant, and John C. Merchant.

The Davison-Namack Foundry Co., Ballston Spa, N. Y., recently incorporated, has bought out the business of Uline Bros., of that city. The plant, while not large, is in good shape as far as convenience is concerned. The foundry is a modern one, and work can be handled up to six tons. The new owners have been repairing the machine shop and have added a jig saw and buzz planer to the pattern shop. Other machinery and equipment will be installed as the business warrants. The company has land enough to enlarge, which it hopes to do within a year.

The stockholders of the Tacony Iron Co., of Tacony, Pa., will meet in Philadelphia on April 27th to vote on an increase in the capital stock of the company from $50,000 to $200,000, the funds thus provided to be used in increasing the capacity of the plant, which is located at Tacony, Pa., and consists of an iron foundry, brass foundry, machine shop, etc.

Mr. C. H. Urick, of Erie, Pa., is at the head of the project for starting a new jobbing foundry in Erie. His three sons will engage in the business with him. They expect to spend about $25,000 in equipping a new plant and will have it in operation in about two months.

The National Elevator & Machine Works, of Honesdale, Pa., has been sold to H. F. Guerney, New York, N. Y.

The Ohio Brass & Iron Mfg. Co., Cleveland, which recently increased its capital, does not intend to erect any buildings at present, but expects to use the new capital in extending its business. Three traveling salesmen have been added to the outside force.

The American Castings & Register Co., of Akron, O., has been incorporated with a capital of $25,000. The incorporators are Daniel Motz, Geo. N. Dugot, Edward H. Arend, Cloyd R. Quine and William H. Kroeger. The company will take over the business of the American Castings Co., the plant will be enlarged and general line of foundry business carried on in addition to the manufacture of hot air registers.

At the annual meeting of the stockholders of the Portsmouth Stove & Range Co., Portsmouth, O., the following officers were elected for the ensuing year. President, F. V. Knauss; F. M. Knauss, vice-president, and Robt. G. Bryan, secretary and treasurer.

D. E. Dangler and Paul Schneider are interested in the formation of a company to be known as the Best Foundry Co., of Bedford, Ohio.

John E. Angell & Co., East St. Louis, Ill., have been incorporated with a capital of $25,000, to conduct a general foundry and machine manufacturing business. The incorporators are: John E. Angell, James G. McHale and W. T. Summer.

The Tuscaloosa Foundry & Machine Co., of Tuscaloosa, Ala., has been formed to carry on a general machine shop and foundry business. The officers are Ed. W. McDonald, president and manager; F. L. McDonald, vice-president, and J. S. Hanson, secretary and treasurer.

The Birmingham Stove & Foundry Co., of Birmingham, Ala., has been organized with a capital of $25,000. The incorporators are H. D. Maus, James M. Jolly, E. M. Chestnutt, J. B. Gibson, W. G. Ester, C. E. Thomas, T. F. Thomas, and T. F. Wimberly. The company expects to manufacture stoves and ranges.

The Whitman Agricultural Co., St. Louis,

Mo., whose pattern building was recently damaged by fire, has not been seriously inconvenienced. The plant is now in operation as formerly.

The Cummings Machine Works has been organized at Boston, Mass., to operate a foundry and machine shop. Henry H. Cummings is president and treasurer, and the capital stock is $25,000.

The Hallcast Foundry Co., Providence, R. I., has been organized recently for the purpose of casting dies by a patent process. Mr. T. Parker Hall, Jr., is the manager.

The Frazer & Jones Co., Syracuse, N. Y., have decided to enlarge their plant by erecting new buildings to be used as foundry and pattern shop. They have also elected the following officers for the coming year: President, R. W. Jones; vice-president, Fred Frazer; treasurer, Chas. R. Jones; secretary, O. P. Letchworth.

G. W. Frazier and brother, of Frankfort, N. Y., have purchased of Wm. Dixon, his machine shop at Adams, Jefferson county, N. Y. They will erect a foundry in the spring and will do general machine business. Mr. Dixon who is 82 years of age, retires after an honorable business career of over 50 years.

John Gilroy and Henry Johnson have formed a partnership for the purpose of carrying on a brass foundry at 252 Whitesboro street, Utica, N. Y.

The plant of the Baldt Steel Casting Co., of New Castle, Pa., is partly completed, the machinery is being installed, and the furnaces gotten ready for operation.

The Marshall Foundry Co., of Pittsburg, Pa., has been incorporated with a capital of $150,000. The directors are W. M. McCulloch, W. D. Marshall, Reid F. Blair, Wm. W. Wishart, of Pittsburg, and Joseph K. Killinghest, Sewickley.

The British steamer Tantalion has arrived in Philadelphia with a cargo of 4,000 tons of pig iron from Middlesborough, England, consigned to a Philadelphia firm to be used in the manufacture of cast iron water pipe and reshipped to England. United States Consul H. Clay Evans, London, reports that 3,150 tons of pig iron were shipped to the United States during December from Middlesborough.

The Mahoning Foundry & Machine Co., of Youngstown, O., have purchased from the executors of the Geo. B. Sennett estate the punch and shear plant. It is announced that the new owners will push the business more energetically than ever before.

The Stark Foundry Co., of Canton, O., has been incorporated with a capital of $5,000. The incorporators are G. P. Bonsky, G. A. Bonsky, G. F. Ebel, P. Bonsky and A. J. Bonsky.

The Canton Malleable Iron Co., Canton, O., is rebuilding its foundry, recently destroyed by fire, as rapidly as possible. The firm is crowded with orders in its foundry department.

The Loveland Foundry Co., Loveland, O., capital $10,000, has been incorporated by Daniel Donnelly, John A. Seymour, Harry Donnelly, George Chambers and Horace B. Jones.

The Aetna Machine & Foundry Co., of Warren, O., has changed hands, Mr. Fred Russell having purchased the interests of Mrs. Lloyd Booth, Chas. H. Booth, H. M. Garlick and Charles W. Bray. This gives him four-fifths of the stock, the remaining one-fifth being owned by his father, J. W. Russell, who is about to retire from active business.

The property of the National Valve Co., Sandusky, O., was sold last week to the bondholders, and a reorganization is to be effected.

The Dennison Foundry Co., of Dennison, O., has been incorporated with a capital of $60,000. The incorporators are: M. Dunn, J. F. Digan, P. F. Smith, Jr., E. D. Moody and W. A. Coldren.

The Ohio Brass and Iron Works Co., of Cleveland, O., has increased its capital stock from $50,000 to $100,000.

The stockholders of the Kelly Foundry & Machine Co., of Goshen, Ind., have elected the following officers for the ensuing year: Frank Kelly, president and treasurer; H. B. Kelly, vice-president and manager of tank department; Charles F. Kelly, secretary and superintendent.

The Wayne Stove Co., of Fort Wayne, Ind., has been organized with a capital of $50,000. The incorporators are Wm. H. F. Moellering, Saml. M. Holtzman, Geo. B. Aldrich, Albert K. Hart and H. W. Dickman.

The old Dorner Truck & Foundry Co.'s plant, Logansport, Ind., is to be reopened and employment furnished to 75 men. The Dorner Mfg. Co., capital stock $100,000, has been incorporated to manufacture car trucks, etc. The directors are: H. A. Dorner, R. D. Buckingham, Oscar Lund, B. H. Walrath and Lloyd J. Smith. Work will begin at once to put the plant in shape for operation. The defunct Dorner Truck & Foundry Co. was organized about four years ago, but through lack of funds and other difficulties was obliged to cease business.

The Mattoon Stove Foundry, of Mattoon, Ill., which has been idle for some time, has started up once more.

The Excelsior Mfg. Co., Chicago, has been incorporated with a capital of $2,500 to manufacture castings and machinery. The incorporators are: L. H. Flint, L. A. Koepfle and Wm. J. Krueger.

The plant of the Fountain City Drill Works, La Crosse, Wis., has been sold to B. E. Edwards, who has leased the plant to the Summit Stove Works, which will use it for the manufacture of stoves. The building will be remodeled and equipped with suitable machinery.

Chas. Walker has started in business in Detroit, Mich., his company being known as the Walker Motor Foundry & Machine Co.

The Oltmer Iron Works, Hoboken, N. J., recently incorporated with a capital stock of $25,000, has taken over the plant and business of Christian Oltmer, of that city, and will manufacture structural and monumental iron.

Sumter Iron Works, Sumter, S. C., which has been conducted by W. E. and John I. Brunson, has been incorporated with a capital stock of $12,000, and the following officers have been elected: John I. Brunson, president; W. E. Brunson, vice-president and general manager; E. W. Moise, secretary and treasurer. The company will be in the market for machinery for installation in its machine shop.

By special act of the county commissioners, the new pipe plant of the Coosa Pipe & Foundry Co., at Gadsden, Ala., has been made exempt from taxation for a period of five years. The city has already exempted the company from city taxation. The new plant will employ 500 men when it is completed.

The Newport Foundry & Machine Co., whose plant at Newport, Ky., was recently sold to the strikers, has changed its name to the Weber Foundry Co., and purchased the foundry plant, contracts and good will of the Wessling Bros., who have operated a foundry at McLean and Sherman avenues, Cincinnati, on the Southern Railroad. The company will continue to make gray iron castings. Henry J. Weber is president.

The Wellsburg Heating, Ventilating & Foundry Co., of Wellsburg, W. Va., expects to make extensive additions to its foundry in future, which will greatly increase its output.

The Davis-Forrest Machine Works, of Savannah, Ga., expects to erect an iron and brass foundry.

The Peacock Iron Works, Selma, Ala., is seeking another location, and may move to Chattanooga, Tenn. The company's specialty is car wheels and cars of all sizes and kinds. The company wishes to triple its capacity.

The Exchange Machine Works, of Birmingham, Ala., has filed a petition in the probate court to change its name to the Vulcan Machine & Foundry Co., and to increase its capital stock from $2,000 to $10,000.

Knoxville Foundry & Machine Co., Knoxville, Tenn., has been incorporated with a capital stock of $25,000. The incorporators are: John P. Staub, Frederick Staub, Charles H. Smith, James H. Weicker and R. H. Sanson.

Nelson Story, Jr., of Bozeman, Montana, is planning to move his foundry from Bozeman to Billings, Montana.

The Great Western Heater Co., of Des Moines, Ia., has been organized by Mr. R. J. Shank. The company will have its headquarters in Des Moines and will manufacture heaters. Mr. Shank has had long experience in this class of work.

The Byron-York Machinery Co., Pueblo, Col., has been incorporated with a capital of $25,000. The company proposes to manufacture gasoline engines chiefly, but has made arrangements for general machine foundry business. The directors are: F. D. Wallaker, O. E. Byron, W. A. Borroughs, H. L. York and A. E. York. The factory is located in Peublo.

The machinery for the new plant of the Grant's Pass Iron & Steel Works, of Grant's Pass, Ore., is being installed and Grant's Pass will soon have the largest foundry in the state south of Portland.

The Tulsa Foundry & Machine Co., of Tulsa, I. T., has been incorporated with a capital of $5,000. The officers are: Ed. C. Reynolds, president; M. B. Baird, vice president; and W. I. Reneau, secretary and treasurer.

The Union Foundry Co., of Seattle, Wash., has been incorporated with a capital stock of $18,000. The incorporators are: Axel Sjostrom, Nels Kartvig and Adolph Swensen.

The Canadian Fairbanks Co., Ltd., has been formed by Henry J. Fuller, of Montreal, Canada. They will take over all the interests of the Fairbanks-Morse Co., including all of their contracts, organization and warehouse stocks, and will establish a plant in Montreal to manufacture the Fairbanks scales and other specialties.

The Ambrose Foundry Co., St. Joseph, Mo., has been incorporated with a capital of $15,000. The board of directors will be composed of S. F. Rowley, S. F. Ambrose and J. M. Johnson.

To the "down to date" Core Maker, these "Greeting"

On another page of this issue of "The Foundry" will be noticed an advertisement of "GLUETRIN" CORE BINDER; "and thereby hangs" (a most adhesive) tale"—as it were.

The similarity in name of "GLUETRIN" to the "GLUTROSE" so long advertised in the columns of this Journal, and so well and widely known to its army of practical readers, naturally suggests either a similar preparation, or a more or less, frank imitation of that "Core Making Compound." Both of these preparations, the former (and henceforth extinct) "Glutrose" and the present "Gluetrin," its successor and supplanter, are traceable to the same source, and just here a little bit of "honest confession" is quite in order.

While "Glutrose Core Compound" (for a compound it certainly was), during its career of ten years won to itself a host of faithful "adherents" who "stuck to it" by reason of its economic possibilities of sticking to their core sands, Glutrose, unfortunately for its makers and users alike, had its limitations, as with a few sands the very best results were not invariably secured.

As the "favorite son" of much practical experiment, "GLUETRIN" now "makes its bow" to the core making world, as a single and simple material for the production of absolutely perfect cores in any and all sands of which its makers have knowledge, and it may be stated in passing, that the makers of "Gluetrin" have hunted down for such experimental purposes every core sand obtainable. It is then, in the light of such comprehensive knowledge, thus practically gained, that they offer in "GLUETRIN" an infallible Core Binder for any and all core sands.

Robeson Process Company,

CAMDEN, N. J.

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Stretching Things a Little

Some advertising matter fits its subject as a flag fits its staff during a calm.

It fits it too much.

Some advertisers grow into the habit of stretching things, even the truth when stretched too much pulls apart.

I avoid all that.

When I say I have the best East India Plumbago or Ceylon Lead on the market I mean just that.

The same statement applies to my complete line of FOUNDRY FACINGS. I make this statement from actual proof—the proof of practice. It also applies to a complete line of FOUNDRY SUPPLIES and PLATERS' SUPPLIES. Don't forget my shop.

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FLUOR SPAR.—Every grade. Quotations delivered anywhere. Cheapest suppliers. Address GEO. G. BLACKWELL SONS & CO., Ltd., Liverpool, Eng., or agents Penna. Salt Mfg. Co., Pittsburg, Pa.

East India Silver Lead. Prices everlastingly lowest, grade everlastingly best. BERG MINING CO., NEW YORK.

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HEATER MANUFACTURERS ATTENTION.—I am a foundryman with an extended experience on the above goods. Would like to open a correspondence with a view of engaging. Will furnish A1 reference from past employers. Can mix from analysis and handle help with intelligence. Address Box 407, care THE FOUNDRY, CLEVELAND, O.

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Roots Second-hand Blowers, bought, sold or exchanged for new ones. Address,

H. M. PAPWORTH,

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FOR SALE.—Foundry, machine and boiler shop. Best equipment within radius of 300 miles. Excellent and growing field for manufacture. Town 10,000 in Oregon. Mining, Agriculture, Saw Milling. Price right. Terms easy. Address "OREGON," Box 408, care THE FOUNDRY, CLEVELAND, O.

FOR SALE.—Manufacturing site occupied by the Brylgon Foundry; located on Lafayette Street in the city of Reading, along Lebanon Valley Railroad; lot 475 x 90 feet; large buildings with power plant; with or without machinery; possession at once. Apply to MENGEL & MENGEL, 9 North 6th Street, READING, PA.

WANTED.—Foreman to take charge of foundry now under construction. Will pour twenty tons daily. Wide range of work, including gears, machinery castings and general work. Must be familiar with machine molding. Address, with full particulars, Box 391, care THE FOUNDRY, CLEVELAND, O.

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FOR SALE.—Foundry and machine shop. Splendid location. Two railroads, two rivers, no other foundry within 25 miles. H. H. MASON, MT. CARMEL, ILL.

FOR SALE.—Five-ton Paxson ladle and set of 10-ft. sling chains, ¾-in. link. Practically good as new. THE GARWOOD FOUNDRY & MACHINE CO., GARWOOD, N. J.

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WANTED.—Position as superintendent or foreman of grey iron foundry. Thoroughly practical and up-to-date in all departments. Best of reference. Address Box 411, THE FOUNDRY, CLEVELAND, O.

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WANTED.—Wood patternmaker, experienced in making patterns for round and sectional cast iron boilers. Address Box 417, THE FOUNDRY, CLEVELAND, O.

WANTED.—A practical non-union foreman and instructor on light floor and bench work. Experience in use of squeezer. Open shop. No trouble. Address Box 414, THE FOUNDRY, CLEVELAND, O.

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FOR SALE.—A small machine shop and foundry located in central Minnesota. Shop and tools are new. Good trade. $1,800 takes it. A rare chance for the right man. Address P. C. WEBB, HUTCHINSON, MINN.

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WANTED.—Position as foundry foreman; 25 years' experience in heavy and light work, loam, dry sand and green. A1 mixer of iron and handler of men. Best of reference. Address Box 413, THE FOUNDRY, CLEVELAND, O.

POSITION WANTED.—By a foundry foreman who would like to make a change; a practical molder with a technical education. Can mix iron by analysis and make analysis if necessary. An A1 cupola man. Address Box 415, THE FOUNDRY, CLEVELAND, O.

FOR SALE OR RENT.—Small foundry being operated in connection with manufacturing plant. Fine opening for good molder, as factory takes large part of foundry output; plenty other work being offered. Only steady, first-class molder need apply. Address NEW SPECIALTY MFG. CO., COUNCIL BLUFFS, IA.

FOR SALE.—A well equipped foundry and machine shop. Solid brick construction 190 x 90 feet, 10-ton cupola, 40 h. p. gas engine, crane, platform scales, tools, foundry supplies, pig iron and scrap. Equipment all new and of the best design. Cheap natural gas from two independent lines; good railroad facilities with switch running length of building. An ideal location for economical production. Located in Elm Grove, a suburb of Wheeling, W. Va., and with frequent electric cars from the city. For further information address Geo. W. Lutz Wheeling, W. Va., or Alexander Chandler, 39 Cortlandt street, New York.

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Very heavy, large wearing surfaces, cutters will remain in line and make clean, close cuts. Fitted with a very simple clutch, the wearing parts of which are made of tool steel. These machines will cut a piece equivalent to ¾ in. square common yellow brass and is guaranteed in every particular.

Cutters are made of best tool steel, 1½ x ⅝ in.	
Depth of throat from cutting edge	10 in.
Space up and down back of cutters	12¼ in.
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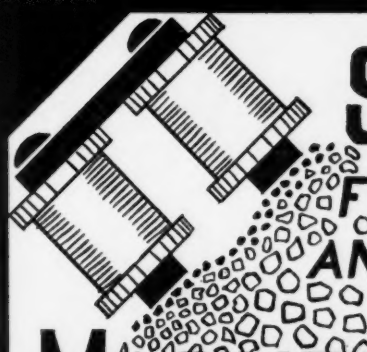

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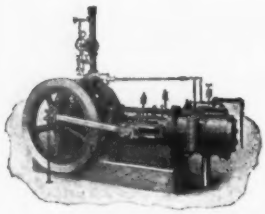

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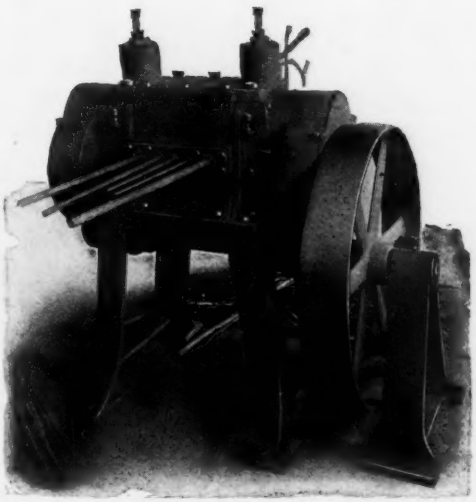

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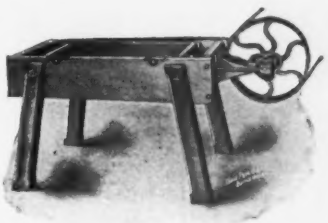

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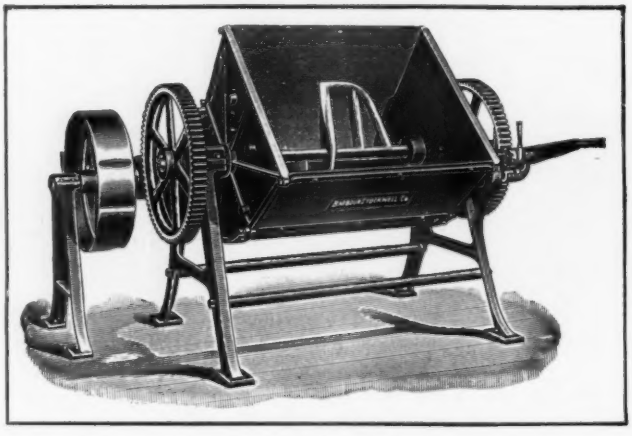

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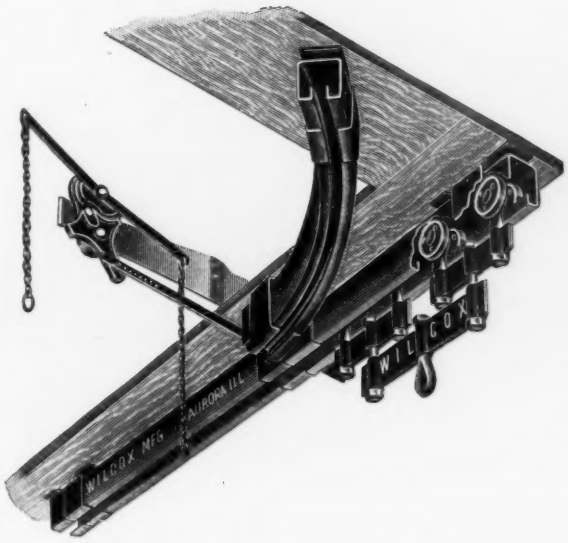

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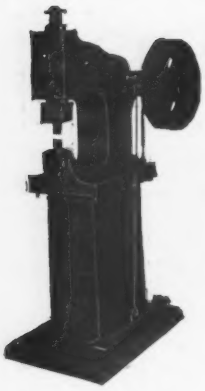

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